# ANATOMICAL VARIATIONS OF THE OSTEOMEATAL COMPLEX IN CHRONIC RHINOSINUSITIS:AN OBSERVATIONAL STUDY

**DEPARTMENT OF OTORHINOLARYNGOLOGY & HEAD NECK SURGERY**

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**FOR THE AWARD OF A DEGREE OF**

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**DR.RAVI GUPTA**

**DEPARTMENT OF ENT**

**SANTOSH MEDICAL COLLEGE & HOSPITAL**

**GHAZIABAD, NCR DELHI**

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Dr**.** SUSHIL GAUR

PROFESSOR

Department of ENT
Santosh Medical College & Hospital
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Co-Guide

Dr(Prof). Tarun Malhotra
HOD
Department of ENT
Santosh Medical College & Hospital
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**PROF. (Dr.) Tarun Malhotra**

M.S.DNB
Professor & Head
Department of ENT
Santosh Medical College & Hospital
Ghaziabad – 201001 (U.P.)

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**Dr. Alka Agarwal**

Dean
Faculty of Medical Sciences
Santosh Medical College & Hospital
Santosh Deemed to be University
Ghaziabad – 201001 (U.P.)

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# INTRODUCTION

# INTRODUCTION

Chronic rhinosinusitis patient is a disease with significant symptoms, such as nasal blockage, nasal discharge, headache, facial pain, and abnormalities in the sense of smell is one of the most common, for which a patient visits an oto-rhino-laryngologist.

Chronic rhinosinusitis is of two forms i.e.

- **Chronic Rhinosinusitis.**
- **Recurrent Acute Rhinosinusitis.**

After MesserKlinger published comprehensive information about the technique of diagnostic nasal endoscopy for diagnosing and treating sinus-related diseases, the approach to dealing with chronic rhinosinusitis has changed markedly.

The aim of endoscopic surgery is removing the obstruction of the osteo-meatal complex, which is considered the main drainage pathway, the obstruction of which perpetuates sino- nasal disease.

Since the osteo-meatal complex is the small compartment located between middle turbinate and lateral nasal wall, representing the major pathway of the drainage of anterior ethmoid, frontal and maxillary sinuses, minimal FESS i.e. functional endoscopic sinus surgery is performed in sino-nasal diseases.

A vicious cycle of events arises due to obstruction of the osteo-meatal complex, which finally leads to the development of sino-nasal disease by causing mucosal congestion that decreases airflow and thus leads to further obstruction.

The treatment of choice involves maintaining the drainage and ventilation of the various paranasal sinuses; this can be achieved only by developing specific diagnostic modalities which ensure appropriate diagnosis and safe intervention.

The diagnostic modalities most commonly used for sino-nasal diseases are CT and nasal endoscopy, which are used to determine bony anatomical variations and mucosal abnormalities of sinuses and are also used to assess the pathogenicity of the findings in patients undergoing evaluation for sino-nasal diseases. Detailed and comprehensive knowledge of the anatomy of

paranasal sinuses, lateral nasal valve, anatomical variants in the region and surrounding vital structures is required by the ENT surgeons to perform endoscopic surgery, which is the recent advancement in the surgical treatment of rhinosinusitis. This knowledge can be explained by the use of CT. The presence of any anatomical variant has not yet been established as etiology for rhinosinusitis. The concept of these variations leading to osteo-meatal obstructions, prevention of mucus drainage and thus finally pre-disposing the patient to chronic rhinosinusitis is still controversial.

Few studies have assessed the commonly accepted role of anatomical variations in the osteo-meatal complex including uncinate process variations, paradoxical curved middle turbinate, agger nasi cells, septal deviations, haller cells, concha bullosa, in the development of sino-nasal disease such as chronic rhinosinusitis patients.

We sought to imply CT and nasal endoscopy and assess the widespread presence of osteo-meatal complex variations in chronic rhinosinusitis.

## SNOT 20-(SINONASAL OUTCOME TEST 20)

This covers a broad range of health and health-related quality of life problems, including ‘physical problems, functional limitations, and emotional consequences. The SNOT 20 provides two principal scores:

(a) Total score ,which is the mean score for all 20 items,
(b) Importance score is the mean score for the five items identified as necessary. A limitation of this questionnaire is that two critical questions are not included, “nasal obstruction & loss of smell.”

### SNOT 22(SINONASAL OUTCOME TEST 22)

It is a further modification of SNOT 20, where the scoring has been simplified by removing the importance rating. In addition to the standard 20-item version of the SNOT 20, two additional items were measured, nasal blockage and loss of smell taste. These items were added to concerns regarding validity of an instrument, not including these symptoms.

# OBJECTIVES

- TO STUDY THE INCIDENCE AND ROLE OF ANATOMICAL VARIATIONS OF THE OSTEO-MEATAL COMPLEX IN CHRONIC RHINOSINUSITIS PATIENTS.

# REVIEW OF LITERATURE

# REVIEW OF LITERATURE

Numerous anatomical variations can complicate the anatomy of the nose lateral wall and the osteomeatal unit conditions. None of the variations is a pathological process per se, i.e., the simple presence of an anatomical variation must not be anatomically interpreted as an indication for a surgical procedure. However, such variations may considerably constrict the narrow clefts of osteomeatal unit, mainly if multiple variations occur in combination, bringing facing mucosal surfaces into contact. These variations predispose to more rapid and frequent appearance and persistence of acute and chronic inflammations[13].

In 2004 Kantarci M et al. suggested that significant anatomic variations of PNS region and their possible pathologic outcomes should be well defined in order to improve the result of mgmt strategies and to avoid potential complications of endoscopic sinus surgery[14].

Previously, standard sinus radiographic techniques failed to adequately detect minimal to moderate degrees of mucosal thickening in the ethmoid sinus and middle meatus region. In 1960 Hounsfield and Ambrose devised the computerized tomography[15]. Since then the, coronal CT scanning has significantly improved the imaging of PNS anatomy as compared to sinus radiographs.

This gives an applied anatomical view of the region and the anatomical variants that are very often found. It proves by far to be the most reliable method of preoperative assessment also. It has the advantage of showing both bony details, using wide window settings, and good soft tissue outline, using narrow window settings. Both axial and coronal views may be of use – although coronal views are more helpful.

Stammberger H recognised that the endoscope allows the practitioner to recognize the changes that may remain from the naked eye and even from inspection with the microscope thereby allowing diagnosis to be made, confirmed, expanded or even revised and the effects of the topical and systemic therapy can be seen and evaluated[16] .

The endoscopic examination also assists the doctor in evaluating the decision whether local/ systemic medical treatment may be fruitful or whether surgery is needed. Hence diagnostic nasal

endoscopy has become a day-to-day part of the evaluation of every patient with evident/suspected disease of the nose and PNS.

Considerable attention has been directed toward the analysis of PNS anatomy through coronal plane CT imaging and nasal endoscopy after the advent of sinus surgery. These investigations aim to asses the mucosal abnormalities & bony anatomic variations of PNS and detect the possible pathogenicity of these results in patients undergoing evaluation for sinusitis/sinus surgery.

The Messerklinger method of functional endoscopic sinus surgery is, first and foremost, a diagnostic concept that relies on two primary and equally important diagnostic modalities; endoscopic examination of the nasal cavities and tomographic analysis of the nasal cavity and paranasal sinuses. Noninvasive diagnostic endoscopy has its limits, and the deeper structures cannot be evaluated by endoscopy alone. Computed tomography (CT) and endoscopy thus complement each other in assessing the individual patient.

The anterior ethmoidal sinuses and the osteomeatal complex are the primary sites of the mucosal pathologic conditions responsible for chronic infection in the major paranasal sinuses. The ethmoidal infundibulum, the hiatus semilunaris, and the middle meatus are the channels through which the frontal, maxillary and anterior ethmoidal air cells drain. Swelling or apposition of the adjacent mucociliary surfaces may result in poor ventilation and obstruction to drainage of the larger paranasal sinuses. Any anatomical variants present in this region, trauma, or hyperplasia of the mucosa from previous infections can narrow these critical channels, impairing drainage from and ventilation of the larger paranasal sinuses, thereby producing chronic sinusitis.

CT of paranasal sinuses is indispensable in identifying diseases that may not be appreciated during routine clinical examination, either with a nasal speculum or even by detailed endoscopic examination. This is particularly true in diseases involving the osteomeatal complex or the posterior ethmoidal and sphenoidal sinuses solely. In these areas CT is extremely valuable because the unsuspected advanced mucosal disease can be effectively demonstrated by high-resolution CT (HRCT). CT of the paranasal sinuses should be considered a mandatory investigation for assessing the presence or absence of pathologic conditions of the paranasal sinuses when recurrent medical treatment has failed. In addition, CT examination of the

paranasal sinuses will provide an anatomical road map of the paranasal sinuses and identify the presence of significant anatomic abnormalities, the location and severity of the disease and the exact location of obstruction.

Tan H et al. noted that the paranasal sinuses' remarkable growth accounts for the vast majority of anatomical variances. They added that a CT scan is a great way to get anatomical details about this area and can also help with the endoscopic examination. The only additional information an MRI can tell you is whether you have thicker mucosa or fluid retention[17].

# ANATOMY

## ANATOMICAL DISCUSSION

Sinus endoscopy and CT slices have aided us to precisely know and understand better the architectural anatomy of the nose & PNS. Considering the anatomy of the lateral wall of the nose is the answer for endoscopic sinus surgery. The lateral wall of the nose is divided into skin lined vestibule and the lateral wall of the nose proper, which is lined by the mucosa, by a ridge “limen nasi or limen vestibuli”. Limen nasi is made by the lower end of the lateral nasal cartilage. The lateral nasal wall proper bears 3 or 4 nasal conchae or turbinate, named from below upward – superior, middle, inferior. The air spaces below and lateral to each is the corresponding opening. The "sphenoethmoid" recess is the region of the nasal cavity located above the topmost concha and beneath the sphenoid bone.

The frontal, anterior ethmoid, and maxillary sinuses drain into the middle meatus, making it a crucial region. The sphenoid drains into the sphenoethmoid recess, while the posterior ethmoid drains into the superior or supreme meatus. The inferior and intermediate conchae start anteriorly at the forehead's vertical plane level and extend downward almost to the choana.

Beginning above the middle of these, the superior concha is about 1/2 as long as the other two. The three conchae posteriorly kind of converge on one another. The nasopharyngeal isthmus, which enters the nasopharynx through the choana, makes up the remaining portion of the nasal cavity behind their posterior ends.

## INFERIOR NASAL CONCHA AND INFERIOR MEATUS:

An independent bone coated in a thick mucous membrane called the inferior nasal concha has a vascular "plexus cavernosus." At the intersection of the middle and anterior thirds of the inferior turbinate, the inferior meatus, which is small anteriorly and posteriorly, is wider and taller. In this instance, the inferior turbinate's "genu" is created by its acute, curving attachment to the lateral wall.

The nasolacrimal duct starts under the genu, 30–40mm from the anterior nares and 15–20mm from the limen nasi. As the duct runs perpendicularly through the mucous membrane and is shielded by a fold called the "plica lacrimalis or valve of Hasner," its opening resembles a slit.

## MIDDLE NASAL CONCHA AND MIDDLE MEATUS:

The middle concha is a part of the ethmoid labyrinth, which forms the lateral nasal wall above the inferior turbinate.

1. **The Uncinate process**: a crescent-shaped ledge of bone, part of the ethmoid.

2. **Bulla Ethmoidalis:** a rounded projection in the middle meatus, contains one or more ethmoid cells with their thin walls. These cells are known as bullar cells or middle ethmoid cells. Some consider it as part of the anterior ethmoid.
3. **Hiatus Semilunaris**: 1/2 moon-shaped distance b/w the posterior free and sharp margin of the uncinate process and bulla ethmoidalis.

the posteroinferior direction, cross the maxillary sinus's natural ostium, and gradually disappear from the superior to the posterior end of the inferior turbinate. As a result, the frontal and anterior ethmoidal air cells' purulent secretions discharge across the maxillary ostium. Anterior ethmoidal air cells primarily drain across the maxillary ostium.

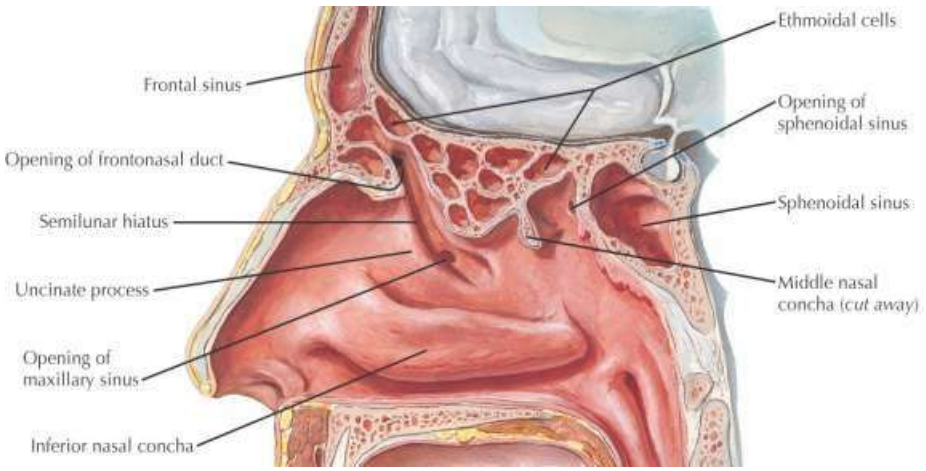



**Figure 1. Middle meatus**

The suprabullar recess is the name of the depression above the bulla. The sinus lateralis is a portion of the middle meatus that is anterior to the middle turbinate's posterior portion, posterosuperior to the bulla.

Between the uncinate process and the bulla is a groove called the ethmoid infundibulum. It extends forward and downward from the semilunar hiatus to a depth that ranges from 0.5 to 10mm (average 5mm). This is dependent on the uncinate process's height.

**Boundaries of infundibulum:**

**Anteromedial and anteroinferior** - Uncinate
Process,
**Posterior** - Bulla Ethmoidalis,
**Medial** - Communicates with middle meatus through the hiatus semilunaris,

**Lateral:** Superiorly - lamina papyracea (separating the orbit)

Inferiorly - maxillary fontanelle (separating the maxillary sinus)

**Anteriorly and superiorly** - the ethmoid infundibulum may form a blind recess (80%)

- the frontoethmoid recess of the infundibulum. In twenty percent of cases, it connects freely with the nasofrontal duct.

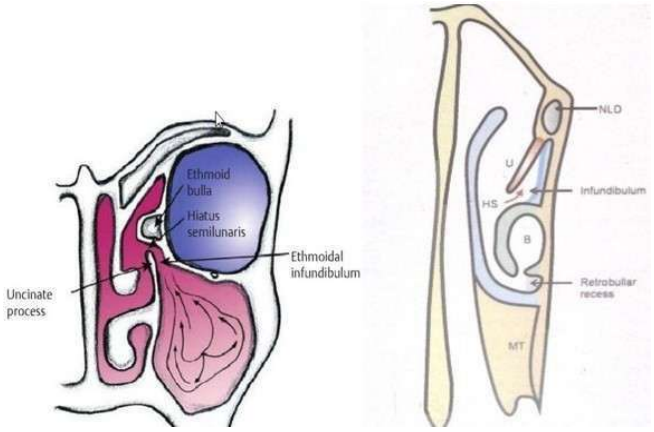



**Figure 2. Ethmoidal infundibulum**

As a result, the frontal sinus either empties directly into the infundibulum via the nasofrontal duct or indirectly through the anterior ethmoid cells. The frontoethmoidal recess is where the anterior ethmoids open, or they might open anterior to it through the uncinate process. The middle ethmoid cells open over the bulla or on top of it (suprabullar recess).

## ETHMOID SINUS

This divides the nasal cavity from the orbit & anterior cranial cavity and is located within the ethmoid labyrinth. The ethmoid labyrinth is generally pyramid-shaped, with the frontal process of the maxilla & nasal process of the frontal bone serving as its anterior limits and the base being posterior to the sphenoid.

It is about 4-5 cm long (anteroposteriorly), 2.5-3 cm high, and about 0.5 cm wide anteriorly and 1.5 cm posteriorly. Thus as a whole, the ethmoid labyrinth forms a thin plate broader posteriorly and thinner anteriorly.

Superiorly, the labyrinthine roof is thicker and is called “fovea ethmoidalis”. This is limited anteriorly by the inferior wall of the frontal sinus and posteriorly bythe sphenoidal bone.

The lateral wall is formed by several bones:

**Anteriorly and above**–frontal bone

**Anteriorly and below** – lacrimal bone (os unguis)

Posterior to these, it is formed by the papyraceous lamina (os planum) of ethmoid above and upper section of the maxillary bone (media wall), and the vertical lamina of palatine bone below.

The ethmoid's inferior wall is absent. It can be thought of as the horizontal plane going along the bottom edge of the middle turbinate since its lower limits are defined by the opening of the middle meatus.

A continuous lamina known as the turbinate (middle, superior, and supreme) and matching meati make up the medial wall of the ethmoid labyrinth. Five main lamellae on the medial wall extend through the labyrinth and towards the lateral wall.

They are:

1. Uncinate process
2. Bulla
3. Middle turbinate
4. Superior turbinate
5. Supreme turbinate

Multiple ethmoid cells are produced due to the asymmetrical placement of the more delicate secondary lamellae between the primary ones. The ethmoids tend to steadily expand outside of the ethmoid during development until they are stopped by hard, dense bone. Intramural cells are those that are found inside the ethmoid bone, and extramural cells are those that are found outside. Thus, the middle turbinate (concha bullosa), the sphenoid, the lacrimal bone, the supraorbital plate of the frontal bone, the infraorbital plate of the maxilla, and the ethmoid cells may all get infiltrated. The degree of pneumatization will undoubtedly affect how the endoscopic sinus surgery goes.

## SPHENOID SINUS

The extent of this sinus's pneumatization varies greatly. Its volume reportedly ranges from 0.5 to 30 ml (average 7.5 ml). About 7 cm separates the anterior wall of the sphenoid sinus from the anterior nares. The sinus can either only affect the body of the sphenoid or it can also affect the basilar region of the occipital bone as well as the greater & lesser wings, anterior clinoid process, pterygoid process, etc. The optic nerve, ICA, maxillary nerve, and other nearby vital relations are

brought more into the sinus cavity as the degree of pneumatization increases, causing matching bulges into the cavities. In these situations, FESS is riskier. The posterior wall of the recess is often where the sphenoid sinus enters the sphenoethmoidal recess. On rare occasions, it might open through the recess' lateral wall.

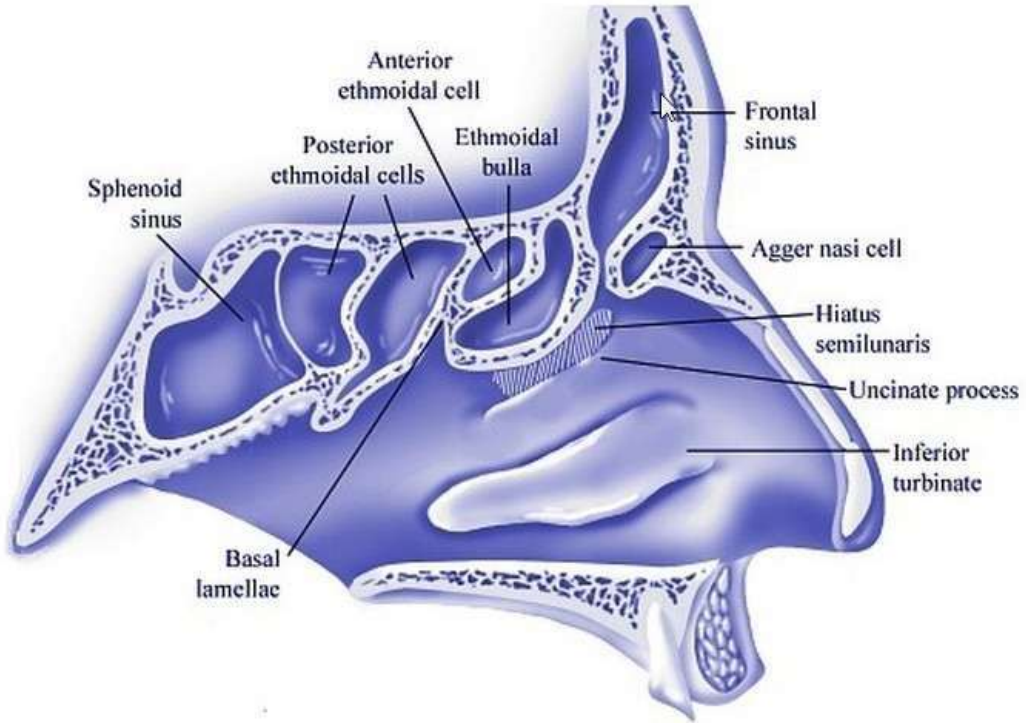



Figure 3.0 sphenoid sinus

## FRONTAL SINUS

This sinus develops in a variety of ways. Similar to the anterior ethmoidal cells, it arises as 1 of the many outgrowths from the frontal recess. Some even believe it is an anterior ethmoid cell infiltrating the frontal bone.

On one or both sides, many sinuses may be lateral to or behind one other. One of these sinuses may leak into the other or drain independently.

Two parts:

I. Vertical (in squama of frontal bone)

II. Horizontal (in the orbital roof of the frontal bone).

The anterior cranial fossa and the orbit are important relations of the frontal sinus. The bone separating the sinus from above is usually thin, and an operative perforation can quickly occur.

## ANATOMIC VARIATIONS

Although the diseased frontal or maxillary sinus may be the source of the clinically dominating symptoms, the underlying reasons are typically not to be discovered in the infected sinuses but rather in the clefts of the lateral wall of the nose. The health of the larger paranasal sinuses depends on the function and patency of these typically tiny clefts of the anterior ethmoidal sinus. The maxillary and frontal sinuses are ventilated and drained via these clefts, which serve as pre-chambers to these larger sinuses. Numerous anatomical variations can make these pre-chambers even smaller, which increases the risk of recurring sinus infections. It is essential to distinguish between pathogenic changes and wide-ranging normal variations in the middle meatus and lateral nasal wall. These differences may in and of themselves be the root of recurrent sinusitis. Although these differences have been observed often in individuals being scanned for a variety of sinus-related issues as well as those being evaluated for issues unrelated to the sinuses, there is a lack of agreement among researchers on their occurrence and clinical significance10. The more common variations can be divided into four groups, depending on the structures involved: Nasal septum, middle turbinate, uncinate process, and ethmoidal bulla.

## NASAL SEPTUM VARIATION

Usually, the components of the nasal septum are arranged in a straight line from the superior cribriform plate to the inferior hard palate. 20% of people have acute bowing and distortion of the septum at the intersection of the nasal cartilage and vomer[18]. The middle turbinate bone may

be compressed laterally by a severely deviated septum, limiting the middle meatus and resulting in blockage, secondary inflammation, and infection. The regular passage of mucus from the sinuses is further obstructed when swollen membranes accompany it.

## MIDDLE TURBINATE VARIATIONS

## CONCHA BULLOSA

Concha bullosa is the medical term for middle turbinate pneumatization. It can be bilateral and has varying degrees of pneumatization. It is not a pathologic finding to have a concha bullosa. Resection of the concha bullosa should be considered in chronic sinus illness to enhance paranasal sinus access.

This region can speak with a concha bullosa pneumatized from the frontal recess. A disease that affects both the frontal sinus and the nearby concha bullosa can develop from this communication. The condition that ranges from mild edema to mucocele in other sinuses may damage the inside of the concha bullosa.

Classified into three types, as per Bolger et al. [10]:

**(A) Lamellar type**

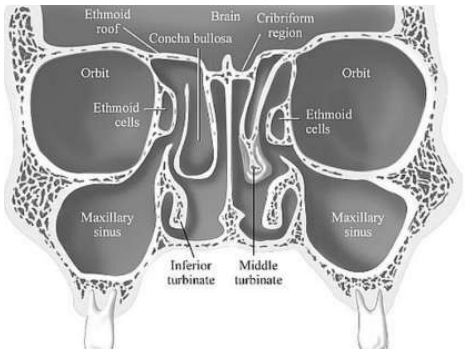
Pneumatisation is localized to the vertical lamella of the middle turbinate.

**(B) Bulbous type**

Pneumatisation of the inferior bulbous part of middle turbinate.

**(C)True or Extensive type**

Pneumatisation of both the vertical lamella and inferior part of the middle




turbinate.

**FIGURE 4 CONCHA BULLOSA**

## PARADOXICALLY BENT TURBINATE

The middle turbinate bone's convexity typically faces medially toward the nasal septum. The convexity is lateral toward the lateral sinus wall, when paradoxically bent. There is a documented incidence of middle turbinates paradoxically bent at 26.1%[10]. Although no studies link this mutation to sinus disease, the deformity and obstruction or alteration of nasal channel airflow dynamics are thought to be causative factors, especially when coupled with other variations[11].

## UNCINATE VARIATIONS

## DEVIATION OF THE UNCINATE

A second middle turbinate bone may form when the superior side of the uncinate tip deviates laterally, medially, or anteriorly out of the meatus[5,11]. It contacts and compromises the middle meatus when medially deviated. The anterior ethmoidal, frontal, and maxillary sinuses could be drained and ventilated if it deviates laterally and encroaches on the hiatus semlunaris and infundibulum. It is unknown how frequently these changes occur and how they relate to sinus disease.

## ENLARGED AND ELONGATED UNCINATE

The ethmoidal bulla may come into close contact with an extended and enlarged uncinate process, greatly narrowing the semilunar hiatus. This constriction may cause blockage in the presence of concurrent mucosal derangements.

## PNEUMATISATION OF THE UNCINATE

Uncinate pneumatization's precise mechanism is not understood. The expansion of agger nasi cells into the uncinate process's most anterosuperior area has been hypothesised to be the cause of this process[10]. Studies show a prevalence of between 0.4% and 2.5%. This mutation has been linked to the infundibulum's constriction, which results in compromised sinus ventilation[19].

## ETHMOIDAL VARIATIONS

## ENLARGED ETHMOIDAL BULLA

Pneumatization of bulla might vary. The sinus of the middle turbinate bone may be filled by a bulla that has been severely pneumatized. According to Stammberger and Wolf, an enlarged ethmoidal bulla may impede the infundibulum or middle meatus, or it may be mostly infected and filled with pus, cysts, or polyps to cause sinus disease[11]. It is unknown how common an enlarged ethmoidal bulla is.

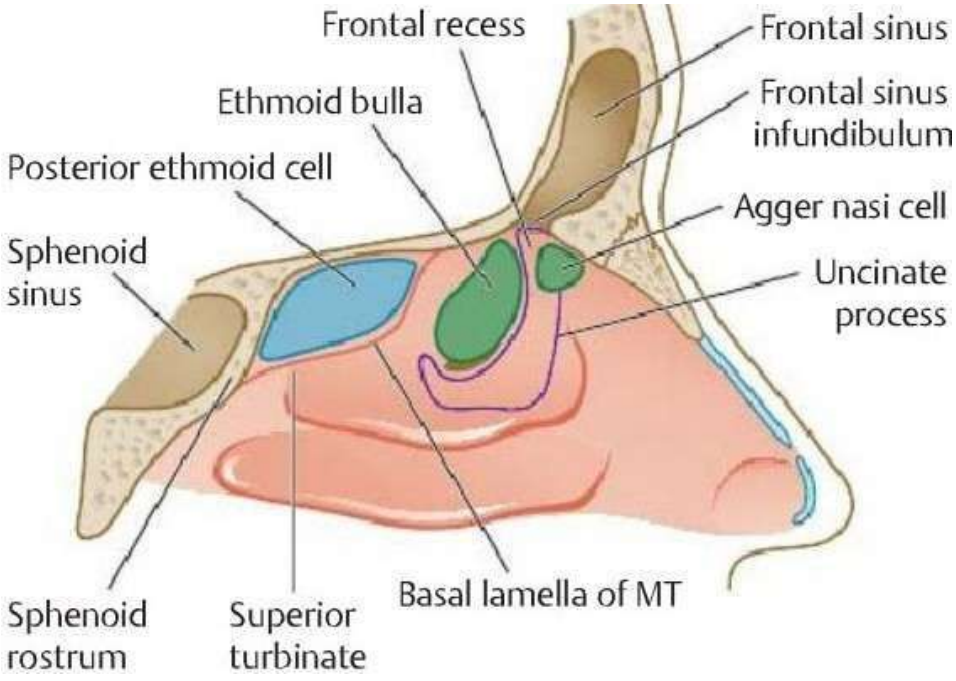


**FIGURE 5 ETHMOIDAL BULLA**

## AGGER NASI CELLS

These are the most constant ethmoidal air cells, representing pneumatization of the lacrimal bone by the expansion of the anterior ethmoidal cells[20]. They are located inferolateral to the lacrimal sinus beneath the frontal sinus. They are situated along the lateral nasal wall, anterior and superior to the insertion of the middle turbinate bone[11]. The percentage of agger nasi cells in anatomical dissections ranges from 10% to 19%. The involvement of these cells can produce eye symptoms due to their proximity to the lacrimal sac. During endoscopy, these cells can allow access to the frontal sinus and recess.

## HALLER CELLS

Haller's cells are ethmoidal cells that form the floor of the orbit (i.e., the roof of the maxillary sinus) next to and above the maxillary sinus ostium. If they become enlarged, they can significantly constrict the posterior aspect of the ethmoidal infundibulum and the maxillary sinus ostium from above.

# REVIEW OF LITERATURE

## HISTORICAL REVIEW

Bony anatomic deviations and mucosal anomalies received special attention from Bolger et al.[10] in their 1987 analysis of 202 patients' coronal plane CT scans. 26.1% of patients had paradoxical curvature of the middle turbinate, 45.1% had Haller's cells, 2.5% had pneumatization of the uncinate process, and 46.2% had middle turbinate lamellar cells. 15.7% of patients had "genuine" concha bullosa, while 31.2% had pneumatization in the bulbous region of the turbinate. Agger Nasi Cell, Crista Galli Pneumatization, Bulla Galli, and Deviated Nasal Septum were all present in 98.5% of patients.

Llyod et al 1991, reported incidence of Haller cells to be 2%, agger nasi cell 3%, concha bullosa 14%, paradoxically curved middle turbinate 17% respectively in chronic rhinosinusitis cases[23].

Scribano et al. 1993 reported the prevalence of 24% Haller cells and concha bullosa 67% in chronic rhinosinusitis cases[24].

In 1993 John Earwarker[25] examined the prevalence of anatomic variations of the nose and sinuses as determined with coronal CT in 800 cases. There were 354 cases of septal deviation (44%) with a male-to-female ratio of 1:1. Of the 354 cases of septal deviation, 34% had significant septal spur. 135 cases showed large paradoxical middle turbinates. Abnormalities of OMU were present in 51% of patients. Anterior ethmoid air cells related to the frontal recess were present in 90% of cases, and agger nasi cells were present in 96% of cases. Extra-mural supraorbital cells were present in 8% of the cases. Pneumatization of the middle turbinate was noted in 55% of c cases, 34 of which were bilateral. Haller‟s cells were seen in 20%, whereas onodi cellswere present in 24% of cases.

Tonai A et al. 1996, reported the prevalence of Haller's cells as 36%, concha bullosa 28%, and agger nasi cell 86.7%, respectively in patients with the sinonasal diseases[26].

Lusk RP et al. 1996, in a study on a total of 115 pediatric cases of chronic sinusitis using coronal CT scans, conducted in St. Louis Children‟s Hospital and Washington University of medicine, St. Louis, Missouri, reported a prevalence of 10% of concha bullosa, 8.5% of paradoxically curved middle turbinate, 10.4% ofnasal septal deviation. It was also reported in the study that the number of abnormalities was not sufficient to enable statistical assessment of the correlation

with sinus disease[27]. Danese M et al. 1997, using a CT scan, Studied the influence of the essential sinonasal anatomic variants on 112 patients aged more than 16 yearssuffering from recurrent, persistent or chronic sinusitis. It was reported that there is anassociation between chronic sinusitis and ipsilateral septal ridges or spurs (33%), and unusual ipsilateral deflexions of the uncinate process (31%). Contralateral septalwatch glass-like deviation (42%) but no correlation was observed for the other studiedvariants (Concha bullosa, paradoxically curved middle turbinate, pneumatized uncinate process, hypertrophic ethmoid bulla, haller cell)[28].

Maru YK et al. 1999, examined 150 chronic sinusitis patients in the outpatient department of Otorhinolaryngology MGM Medical College, Indore. All the patients had coronal CT scans of the paranasal sinus. CT scans were carefully analyzed for middle turbinate pneumatization and osteomeatal complex disease. Of these patients, 41.3% were found to have concha bullosa, but the effect of the presence of concha bullosa on osteomeatal complex disease was statistically insignificant[29].

Liu X et al. 1999, conducted a study at Third Affiliated Hospital Sun Yat-Sen university of medical sciences, Guangzhou, to explore the relationship between the anatomic variations in the osteomeatal complex and chronic sinusitis in 297 individuals. Statistical analysis were carried out with SPSS 5.0. There were 81.14%of OMC noted to have at least one variation[30].

| | |
|---|---|
| Paradoxical curvature of the middle turbinate | 13.97% |
| The pneumatised middle turbinate | 34.85% |
| Uncinate hyperplasia | 19.36% |
| Deviation of uncinate | 45.27% |
| Large ethmoidal bulla | 30.30% |
| Large agger nasi | 0.70% |
| Haller cell | 1% |

Asruddin et al. 2000, while assessing the role of low-dose CT in 50 patients of chronic sinusitis, observed that the commonest anatomical variants were deviated nasal septum (38%), other variants found were concha bullosa in (28%) and Haller cell in 28% cases. The commonest disease pattern was osteomeatal unit pattern in 36% of cases. The infundibular pattern was seen in 23%, the sphenoethmoidal recess pattern in 12% and the sino-nasal polypopsis pattern was present in 16% of the cases[31].

Perez Pinas et al. 2000[32] conducted a study on 110 Spanish subjects regarding anatomical variants observed in nasal fossae and paranasal sinuses using CT in the coronal plane. It showed significant anatomical variability, and a high percentage (67%) presented one or more anatomical variants, the variations most observed were in order.

1. DNS

2. Concha bullosa

3. Bony spur of the septum

4. Onodi air cell.

Among the three subtypes of concha bullosa, only bulbous type seems strongly associated with symptoms[33].

Stallman JS et al. 2004, retrospectively searched a database of the Department of radiology the Mount Sinai School of Medicine of New York University for all paranasal sinus CT studies conducted between 2001 and 2002. It was found in the study that 65% of the patients had nasal septal deviation, and 44% of the patients hadat least one concha bullosa. It was also observed that there was no increased incidenceof paranasal sinus disease in patients with concha bullosa or nasal septal deviation[34].

Caughey RJ et al. 2005 conducted a study to examine the correlation between anatomic variants and chronic sinusitis. 250 consecutive sinus and orbital CT scans were examined at the University of Virginia over 2 year period. Of the 500 sides, 67.2% of sides had some level of mucosal thickening. Concha bullosa and infra orbital ethmoidal cells were present in 27%. Concha bullosa was associated with maxillary sinus disease. Infra orbital ethmoid cells were associated with both ethmoid and maxillary mucosal disease. Narrow nasal cavaties were associated with maxillary sinus disease[35].

Dua et al. 2005 evaluated 50 patients and found in the majority of patients OMC and anterior ethmoids were involved (88%). Agger nasi (40%) were the most common anatomical variations followed by concha bullosa and Haller cell (16%). Apart from this, DNS was found in 44% of patients. This study revealed various

anatomical variations, which were responsible for the primary pathology of the patient[9].

Ameri AA et al. 2005 conducted a case-control study to see the role of anatomic variants of paranasal sinuses in causation of chronic sinusitis in Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran. It was observed that septal deviation and concha bullosa of the middle turbinate were the anatomic variants significantly associated with chronic sinusitis. Besides, agger nasi cell and inverted uncinate process were related to ethmoid and frontal sinusitis, respectively[36].

Wani et al. 2009 conducted a study on 150 patients of chronic rhinosinusitis in the Department of ENT, Head and Neck Surgery, Government Medical College, Srinagar over 2 years. It was reported from the study that concha bullosa was the commonest anatomic variation and was seen in 45 (30%) patients. The other anatomic variations noted included: paradoxical middle turbinate in 9.33% of patients,uncinate process variations in 25% of patients, agger nasi cell in 9.33% of patients,Haller cells in 8.66% of patients, and postero-septal deviations in 25.33% of patients. The mucosal disease was most commonly seen in anterior ethmoids 87.33%, followed by maxillary sinus Ostia 70%, maxillary sinus disease at 65.33%, posterior ethmoid disease at 38%, frontal sinus disease 15% and sphenoid sinus mucosal disease 8.66% patients[1].

Daghighi MH et al 2007[37], in their study collected 292 CT-scan cliché samplesfor evaluating the anatomic variations and their prevalence. These patients werebetween 15-50 years old and they

did not have any pathology in their sinuses. According to the results, the septal deviation (34.24%) was the most common anatomical variation and the other cases were sequentially as follow: Agger nasi cell

36.22%, concha bullosa 15.90%, hypo plastic frontal sinus 6.24%, aerated septum 2.62%, haller cell 1.41%, onodi cell 0.40%.

Mamatha H et al 2010, conducted a CT scan study on the variations of the osteomeatal complex and its applied anatomy. It was observed in the study that the prevalence of nasal septal deviation was 70%, agger nasi cell 50%, haller‟s cell 17.5%, concha bullosa 15%, deviated uncinate process 65% respectively. The mucosal thickening was observed in maxillary sinus in 67.5% cases, ethmoidal sinus in 32.5% cases and frontal sinus in 25% cases[38].

Alkire BC et al 2010, made an assessment of sinonasal anatomic variants potentially associated with recurrent acute rhinosinusitis in a case control study approved by Brigham and Womens‟s Hospital committee. They reported among the various sinonasal anatomic variants, concha bullosa was observed in 41.7% of the patients, impinging septal spur in 27.8% and haller cells in 39.9% of the patients inthe RARS group respectively. But only the presence of Haller cells was significantly associated with the likelihood of RARS compared to non CRS-controls[39].

Mohannad A. Al-Qudah 2017, in a computed tomographic study regarding anatomical variations in sinonasal region analysed 110 consecutive nasal and paranasal sinus CT scans of 110 patients who attended otolaryngology clinic at King Abdullah University Hospital (Irbid, Jordan). It was reported in the study that agger nasi cell was the most common variation and was observed in 80% of the patients, Concha bullosa was the second most common variant observed in 62% of the patients.A total of 33% patients had nasal septal deviation. Haller‟s cell and paradoxically curved middle turbinate were seen in 20% and 18% of the patients respectively[40].

Vincent TES et al 2018, conducted a retrospective study of chronic rhinosinusitis patients who underwent FESS in the Department of Otorhinolaryngology, Head and Neck surgery at Hospital University KebangsaanMalaysia, Kuala lumpur. The prevalence rate of 25.5% of concha bullosa and 46.7% of nasal septal deviation was observed in the study. It was also reported in the study that the presence of Concha bullosa did not statistically contribute to an increased incidence of ipsilateral chronic rhinosinusitis cases. Similarly no significant association was seen between the

rate of ipsilateral and contralateral side of CRS in relation to the presence or absence of ipsilateral or contralateral DNS[41].

# METHODOLOGY

## METHODOLOGY

This present study titled "ANATOMICAL VARIATIONS OF OSTEOMEATAL COMPLEX IN CHRONIC RHINOSINUSITIS: AN OBSERVATIONAL STUDY" using diagnostic nasal endoscopy and computed tomography was conducted in the department of E.N.T. of SANTOSH MEDICAL COLLEGE & HOSPITAL, teaching hospitals from OCT 20 TO APRIL 22

## SOURCE OF DATA

All the patients attending the E.N.T. department, who had chronic sinusitis for more than three months duration.

## SAMPLE SIZE

Using the statistical formula

$n=z^2_{1-\alpha}p(1-p)/l^2$

taking the prevalence ofanatomical variations of osteomeatal complex in chronic sinusitis as 65%[33] and 95%confidence intervals and allowable error as 13%. Due to limited time sample size was taken to be 50.

## INCLUSION CRITERIA

Pts between ages of 15 and 70 yrs suffering from chronic rhinosinusitis.

## EXCLUSION CRITERIA

- Patients with altered ciliary motility like

    1. Immotile cilia syndrome
    2. Kartageners syndrome
    3. Down's syndrome

4. Cystic fibrosis

- Polypoidal or other expansive lesions
- Patients with surgical or traumatic antecedents in the nasosinusal region
- Patients with facial disturbances
- Patients with acute infections
- Patients with fungal sinusitis
- Patients with malignancy

## METHOD OF COLLECTION OF DATA

1) The cases selected for the study were subjected to detailed history taking and examination.
2) A routine haemogram (Haemoglobin, Bleeding time, Clotting time, Total count, Differential count) and urine examination (albumin, sugar, microscopy), a swab from the middle meatus for culture sensitivity along with X-ray paranasal sinuses were done for the patients.
3) All the patients in the active stage of the disease were treated with a course of suitable antibiotics, antihistamines and local decongestants. They were also treated for medical conditions like diabetes mellitus, hypertension, and nasal allergy. No patient received steroid therapy or immunotherapy.
4) Each patient underwent a systematic diagnostic nasal endoscopy and computed tomography of the nose and paranasal sinuses.

## EQUIPMENT USED

- ❖ Antifog solutions (Savlon).

- ❖ Suction apparatus, Cannula, Ball probe and Freer's elevator.

- ❖ Nasal endoscope: Karl Storz Hopkins rod optical with cold light source and fiber optic light delivery system. Endoscopes used were with $0^0$, $30^0$ and $70^0$ angles of view of 4mm diameters.
- ❖ Karl Storz Endovision Telecam deluxe camera system with monitor.

- ❖ Topical decongestant and anesthetic agent (4% Xylocaine with 1:100000 adrenaline).

5) **Position:** Supine with head slightly elevated and turned towards the examiner, standing at the patient's right side.
6) **Anaesthesia:** Topical decongestant 4% Xylocaine with 1:100000 adrenaline solutionusing applicators like cottonoid strips.
7) **Procedures:** Endoscopy was performed by three passes.

## First Pass:

Along the floor of the nasal cavity towards the nasopharynx to visualize the status of inferior turbinate and meatus, eustachian tube orifice, nasopharyngeal mucosa, nasolacrimal duct orifice and any pathological variations.

## Second pass:

The scope was inserted along the superior surface of the inferior turbinate. As theendoscope was withdrawn, the sphenoid ostium, spheno-ethmoidal recess,and superior nasal meatus were visualized.

## Third Pass:

Examination of the middle meatus in detail.

## Computed tomography:

The CT scan is the gold standard investigation in all sinus diseases, and it gives detailed bony anatomy of the osteomeatal area and serves as a roadmap for the operating surgeon. The coronal plane is the preferred imaging plane that best displays the osteomeatal unit. After obtaining the preliminary lateral topogram of the skull, the area of scanning was defined to include the region from roof of the frontal sinus upto the hard palate. Images were obtained in the coronal plane using 5 mm slice thickness from the anterior wall of the frontal sinus to the posterior wall of the sphenoid sinus. The scans thus generated were photographed at appropriate window widths and window levels. They were analyzed for anatomical variations and mucosal abnormalities.

# RESULTS

# RESULTS

The present study was conducted in the Department of E.N.T., Santosh Medical College & Hospital, Ghaziabad. The study subjects included 50 consecutive patients of chronic sinusitis during the period from oct 20 to April 22, in whom we searched for anatomical variations using diagnostic nasal endoscopy and computed tomography images.

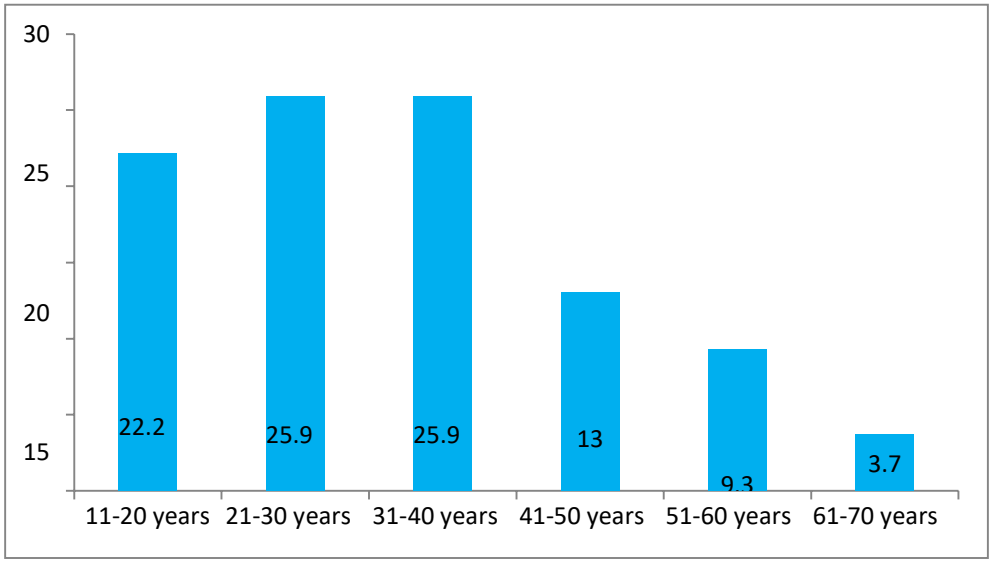
# AGE AND SEX DISTRIBUTION

The patients in our study range in age from 15 to 70 years old. With an equal number of patients aged 21–30 and 31–40, 74% were considerably younger because they were either under or equal to 40 years old.

**TABLE 1:AGE DISTRIBUTION OF THE STUDY SUBJECTS**

| Age Group | Frequency | Percentage (%) |
|---|---|---|
| 11-20 | 11 | 22.2 |
| 21-30 | 13 | 25.9 |
| 31-40 | 13 | 25.9 |
| 41-50 | 6 | 13.0 |
| 51-60 | 5 | 9.3 |
| 61-70 | 2 | 3.7 |
| **Total** | **50** | **100** |

**Graph 1. Age distribution of the study subjects**



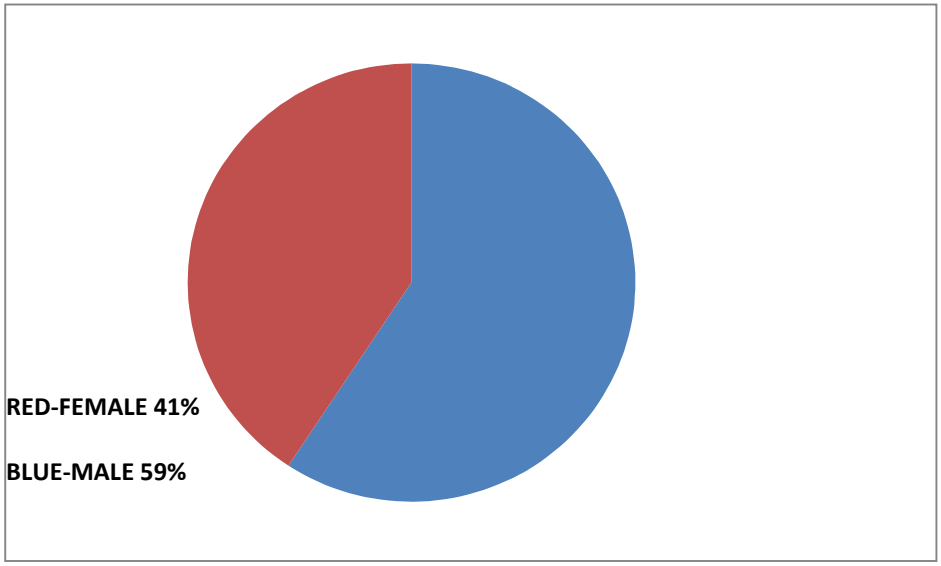

## SEX DISTRIBUTION

Our study showed male preponderance i.e. 59.3% male and 40.7% female.Thus male to female ratio was 1.45:1.

**Table 2. Sex distribution of the study subjects**

| Sex | Frequency | Percentage (%) |
|---|---|---|
| Male | 30 | 59.3 |
| Female | 20 | 40.7 |
| **Total** | **50** | **100** |

**Graph 2. Sex distribution of the study subjects**



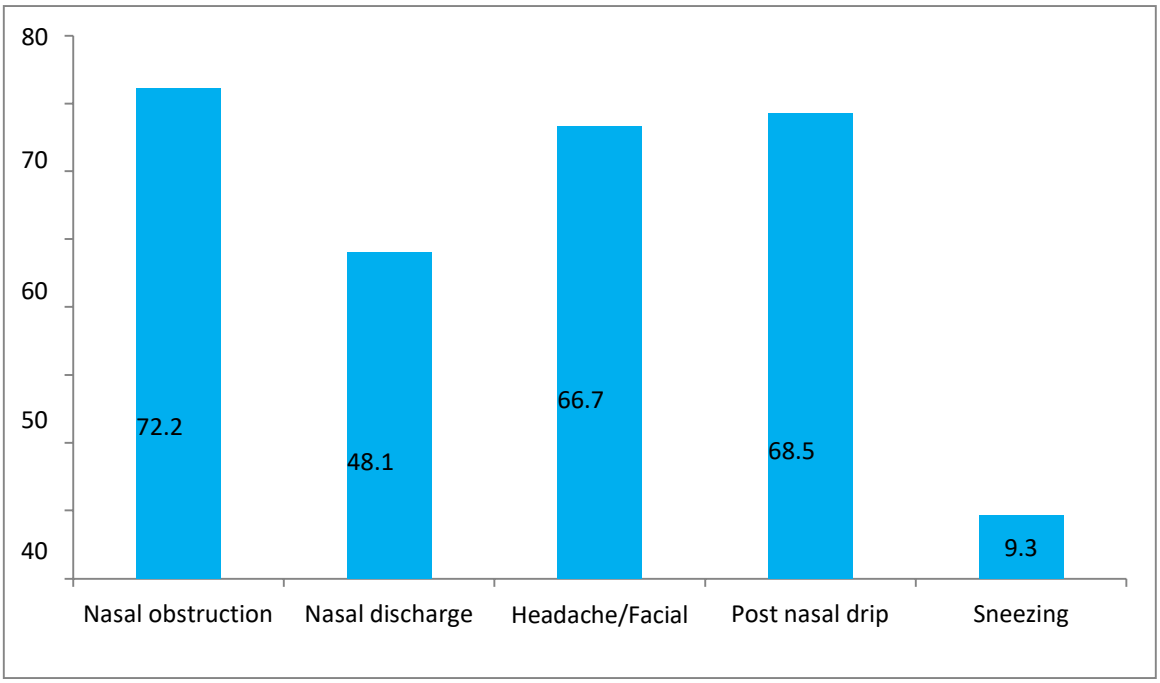

## SYMPTOMS

In our study, the majority of the patients complained of nasal obstruction, which was then followed by postnasal drip, headache/facial pain, and nasal discharge. Only 9.3% of the study patients were found to have sneeze as a presenting complaint or as a component of a complex of symptoms related to chronic sinusitis.

**Table 3. Symptoms presentation of the study subjects**

| Symptoms | Present | Absent | Total |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| Nasal obstruction | 37 (72.2) | 13 (27.8) | 50 (100) |
| Nasal discharge | 24 (48.1) | 26 (51.9) | 50 (100) |
| Headache/Facial Pain | 34 (66.7) | 16 (33.3) | 50 (100) |
| Post nasal drip | 35 (68.5) | 15 (31.5) | 50 (100) |
| Sneezing | 3 (9.3) | 47 (90.7) | 50 (100) |

**Graph 3. Symptoms presentation of the study subjects**



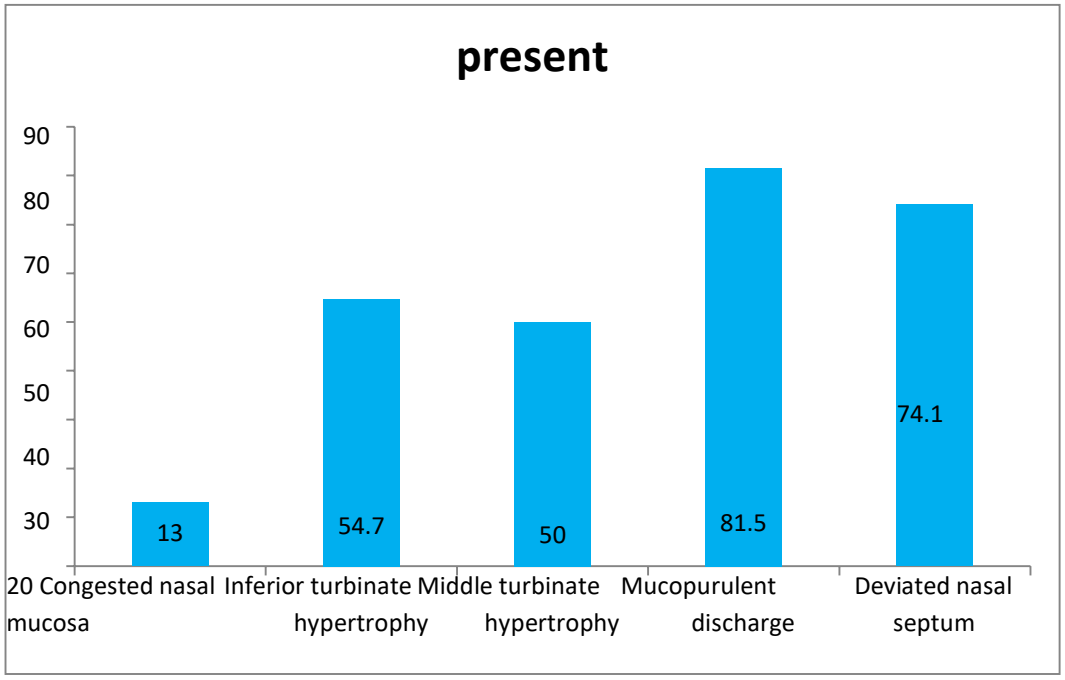

## SIGNS

On clinical inspection, mucopurulent discharge was seen in 81.5% of the cases in our study. The compensatory inferior turbinate hypertrophy and deviated nasal septum, respectively came next. Only 13% of instances reported congested nasal mucosa as the presenting sign, alone or in conjunction with other indicators, while 50% of cases had middle turbinate hypertrophy.

**Table 4. Signs presentation of the study subjects**

| Signs | Present | Absent | Total |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| Congested nasal mucosa | 5 (13) | 45 (87) | 50 (100) |
| Inferior turbinate hypertrophy | 29 (54.7) | 21 (42.6) | 50 (100) |
| Middle turbinate hypertrophy | 25 (50) | 25 (50) | 50 (100) |
| Mucopurulent discharge | 34 (81.5) | 16(18.5) | 50 (100) |
| Deviated nasal septum | 38 (74.1) | 12 (25.9) | 50 (100) |

**Graph 4. Signs presentation of the study subjects**

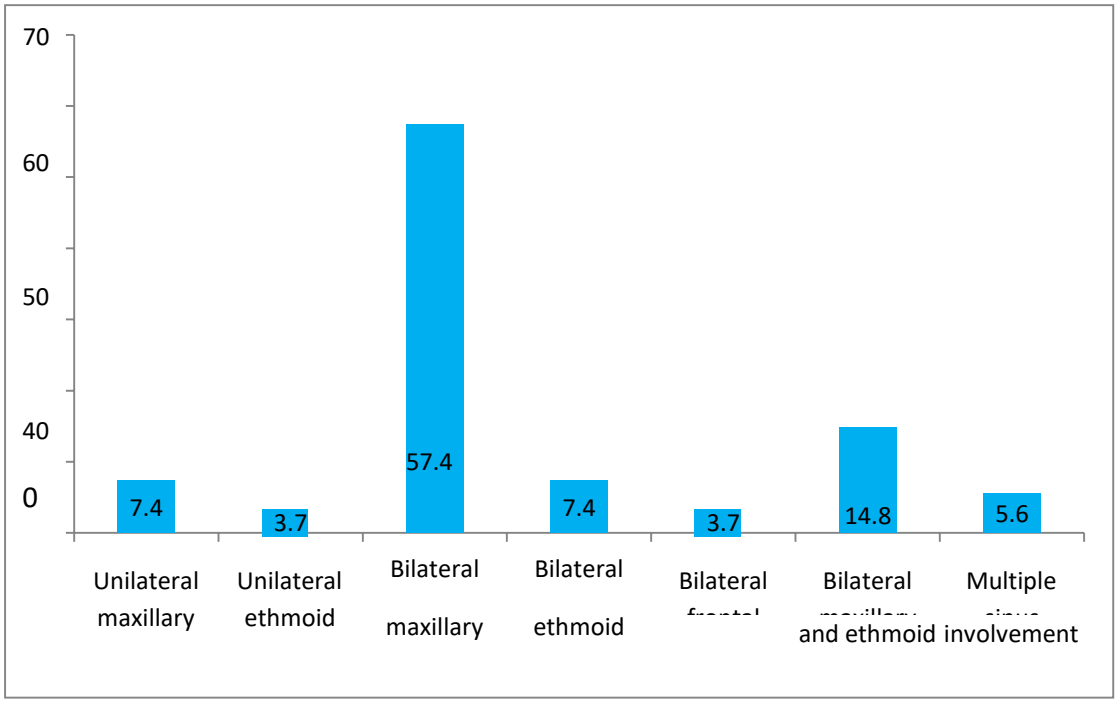


## DIAGNOSIS

Bilateral maxillary sinusitis was the diagnosis in 57.4% of cases, while several sinuses were implicated in 5.6% of cases.

Table 5. Distribution of the study subjects by diagnosis

| Diagnosis | Frequency | Percentage(%) |
|---|---|---|
| Unilateral maxillary sinusitis | 4 | 7.4 |
| Unilateral ethmoid sinusitis | 2 | 3.7 |
| Bilateral maxillary sinusitis | 30 | 57.4 |
| Bilateral ethmoid sinusitis | 3 | 7.4 |
| Bilateral frontal | 2 | 3.7 |
| Bilateral maxillary and ethmoid sinusitis | 6 | 14.8 |
| Multiple sinus involvement | 3 | 5.6 |
| **Total** | **50** | **100** |




**Graph 5. Distribution of the study subjects by diagnosis**

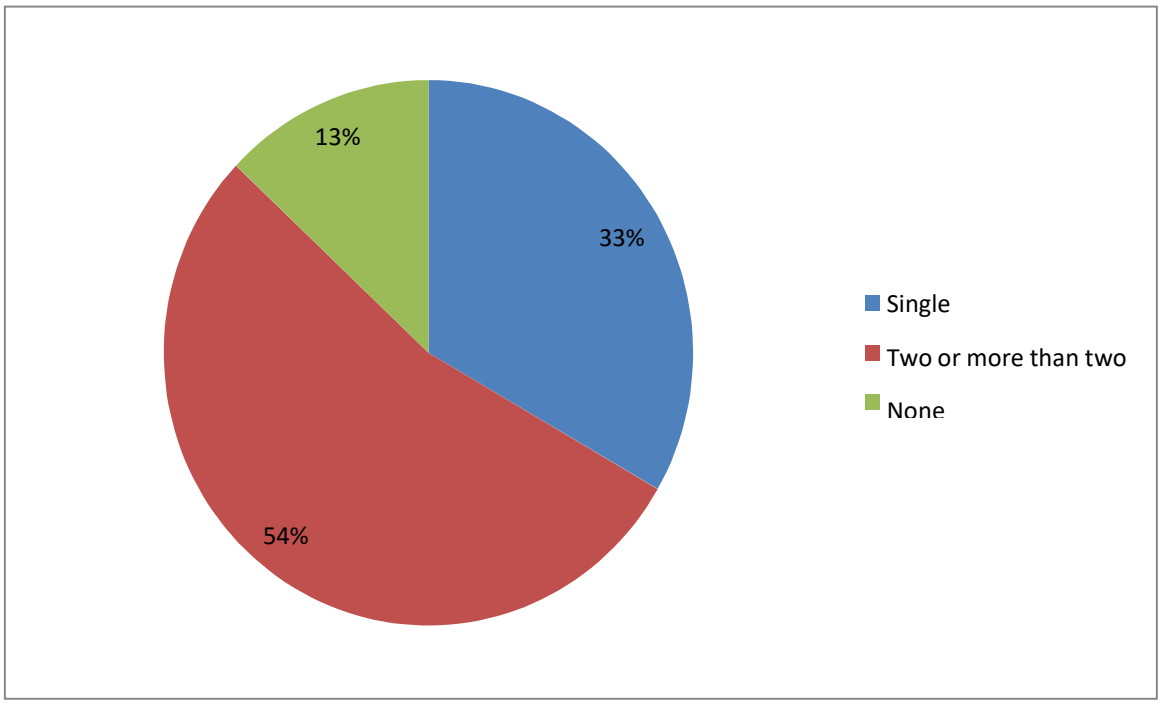
## ANATOMICAL VARIATIONS

In our study it was observed that 53.7% of the chronic sinusitis cases had 2or more anatomical variations and 33.3% of the cases had single anatomical variation.

Table 6. Prevalence of anatomical variations in study subjects

| Anatomical variations | Frequency | Percentage(%) |
|---|---|---|
| Single | 17 | 33.3 |
| Two or more than two | 27 | 53.7 |
| None | 6 | 13.0 |
| **Total** | **50** | **100** |

**Graph 6. Prevalence of anatomical variations in the study subjects**

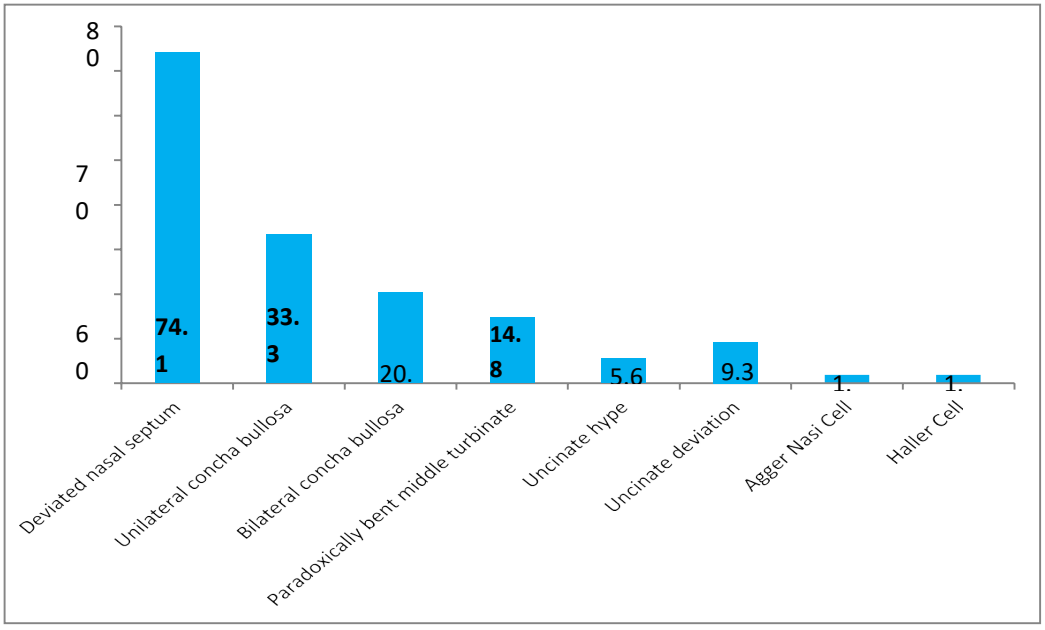



In the current investigation, it was discovered that a deviated nasal septum was the most prevalent among the structural changes in chronic sinusitis cases. This was followed by a unilateral concha bullosa and a paradoxically bent middle turbinate. In one case each, an Agger nasi cell and a Haller cell were observed.

**Table 7. Distribution of anatomical variations in study subjects**

| Anatomical variations | Present | Absent | Total |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| Deviated nasal septum | 38 (74.1) | 12 (25.9) | 50 (100) |
| Unilateral concha bullosa | 16 (33.3) | 34 (66.7) | 50 (100) |
| Bilateral concha bullosa | 19 (20.4) | 41 (79.6) | 50 (100) |
| Paradoxically bent middle turbinate | 6 (14.8) | 44 (85.2) | 50 (100) |
| Uncinate hypertrophy | 1 (5.6) | 49 (94.4) | 50 (100) |
| Uncinate deviation | 3 (9.3) | 47 (90.7) | 50 (100) |
| Agger Nasi Cell | 1 (1.9) | 49 (98.1) | 50 (100) |
| Haller Cell | 1 (1.9) | 49 (98.1) | 50 (100) |

**Graph 7. Distribution of anatomical variations in study subjects**

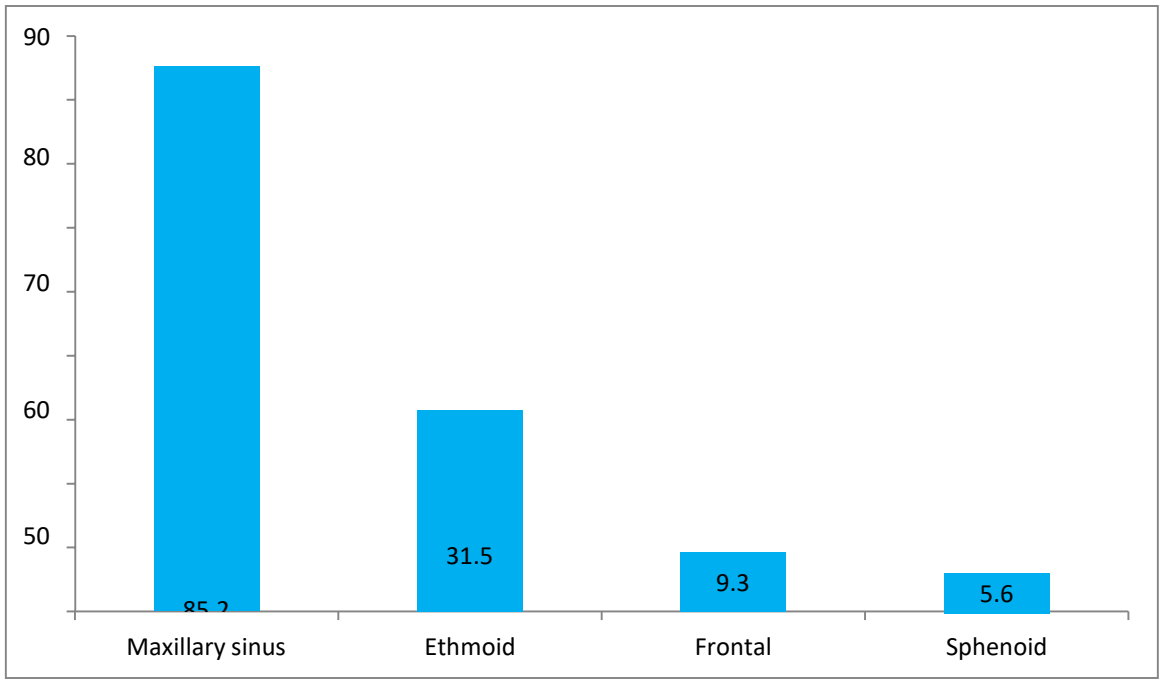


**SINUS INVOLVED**

The maxillary sinus was involved in 85.2% of the participants in our study, followed by the ethmoid, frontal, and sphenoid sinus.

**Table 8. Frequency of sinus involvement in the study subjects**

| Sinus involved | Present | Absent | Total |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| Maxillary sinus | 44 (85.2) | 6 (14.8) | 50 (100) |
| Ethmoid | 15 (31.5) | 35 (68.5) | 50 (100) |
| Frontal | 3 (9.3) | 47 (90.7) | 50 (100) |
| Sphenoid | 1 (5.6) | 49 (94.4) | 50 (100) |




**Graph 8. Frequency of sinus involvement in the study subjects**

**Factors responsible for involvement of a particular sinus:**

Although 85.2% of the study individuals had maxillary sinus involvement, we found that, among all the structural abnormalities in the osteomeatal complex, the presence of nasal septal deviation and concha bullosa were highly related with it (Table 9). However, the presence of a deviated nasal septum, concha bullosa, a middle turbinate that paradoxically bent, uncinate variants, agger nasi cells, and haller cells was not observed to be associated with ethmoid sinus involvement (Table 10). Similar results were seen for frontal sinus involvement, when no statistically significant factors could be discovered (Table 11). But it was discovered that the combined presence of either of the previously listed conditions was statistically related to the involvement of the ethmoid sinus.

Table 9. Association of anatomical variations with maxillary sinus involvementin chronic rhinosinusitis cases

| | | Maxillary sinus involvement | |
|---|---|---|---|
| Factors | | Yes | No |
| Deviated nasal septum | Present | 36 | 2 |
| | Absent | 8 | 4 |
| Concha bullosa | Present | 27 | 0 |
| | Absent | 17 | 6 |
| Paradoxically bent middle turbinate | Present | 7 | 0 |
| | Absent | 37 | 6 |
| Uncinate hypertrophy | Present | 1 | 0 |
| | Absent | 41 | 8 |
| Uncinate deviation | Present | 2 | 1 |
| | Absent | 42 | 5 |
| Agger nasi cell | Present | 0 | 0 |
| | Absent | 43 | 7 |
| Haller cell | Present | 0 | 0 |
| | Absent | 45 | 5 |
| AnatomicalVariation | Present | 42 | 3 |
| | Absent | 2 | 3 |

**Table 10. Association of anatomical variations with ethmoid sinus involvement in chronic rhinosinusitis cases**

| | | Ethmoid sinus involvement | |
|---|---|---|---|
| Factors | | **Yes** | **No** |
| Deviated nasal septum | Present | 10 | 28 |
| | Absent | 5 | 7 |
| Concha bullosa | Present | 7 | 20 |
| | Absent | 8 | 15 |
| Paradoxically bent middle turbinate | Present | 1 | 5 |
| | Absent | 14 | 30 |
| Uncinate hypertrophy | Present | 0 | 2 |
| | Absent | 16 | 32 |
| Inverted Uncinate | Present | 0 | 3 |
| | Absent | 15 | 32 |
| Agger nasi cell | Present | 0 | 0 |
| | Absent | 18 | 32 |
| Haller cell | Present | 0 | 0 |
| | Absent | 15 | 35 |
| Anatomical Variation | Present | 11 | 34 |
| | Absent | 4 | 1 |

**SIGNIFICANT

**Table 11. Association of anatomical variation with frontal sinus involvement in chronic rhinosinusitis cases**

| | | **Frontal sinus involvement** | |
|---|---|---|---|
| Factors | | **Yes** | **No** |
| Deviated nasal septum | Present | 3 | 35 |
| | Absent | 2 | 10 |
| Concha bullosa | Present | 1 | 25 |
| | Absent | 4 | 20 |
| Paradoxically bent middle turbinate | Present | 0 | 8 |
| | Absent | 5 | 37 |
| Uncinate hypertrophy | Present | 0 | 3 |
| | Absent | 5 | 42 |
| Uncinate deviation | Present | 1 | 4 |
| | Absent | 4 | 41 |
| Agger nasi cell | Present | 0 | 1 |
| | Absent | 5 | 44 |
| Haller cell | Present | 0 | 1 |
| | Absent | 5 | 44 |
| Anatomical variation | Present | 3 | 40 |
| | Absent | 2 | 5 |

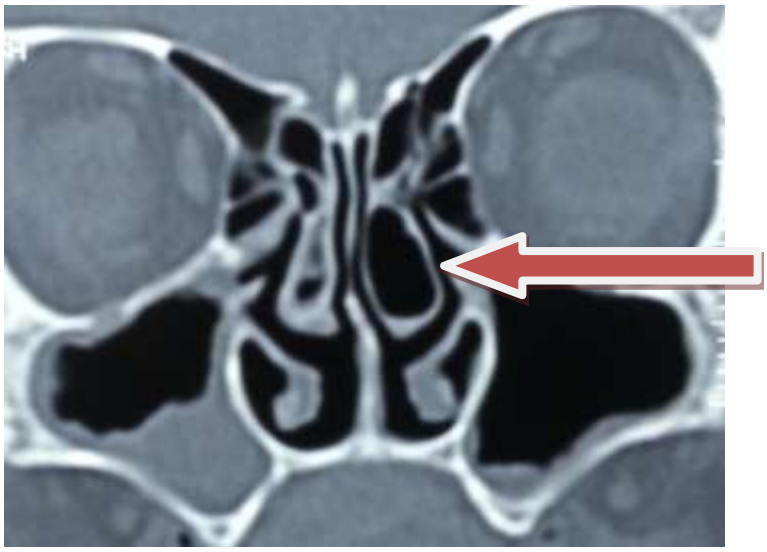


**Figure 6. Concha Bullosa**

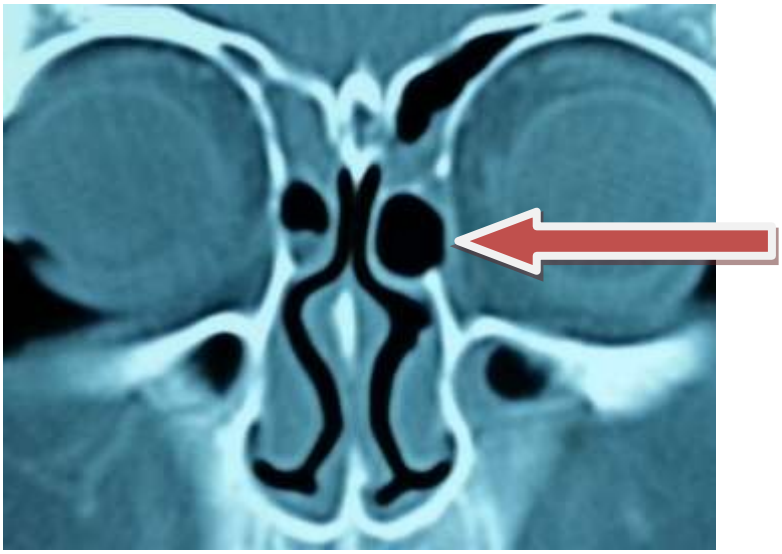


**Figure 7. Agger Nasi Cell**

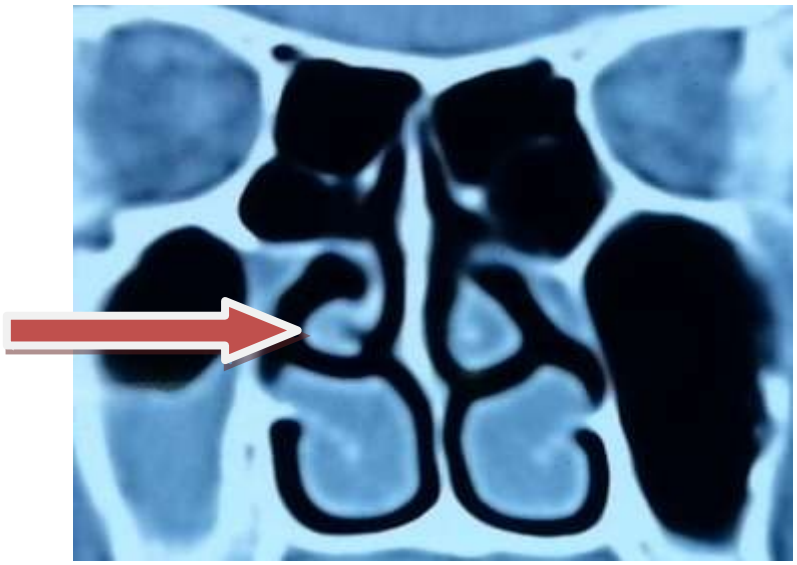


**Figure 8. Paradoxcically bent middle turbinate**

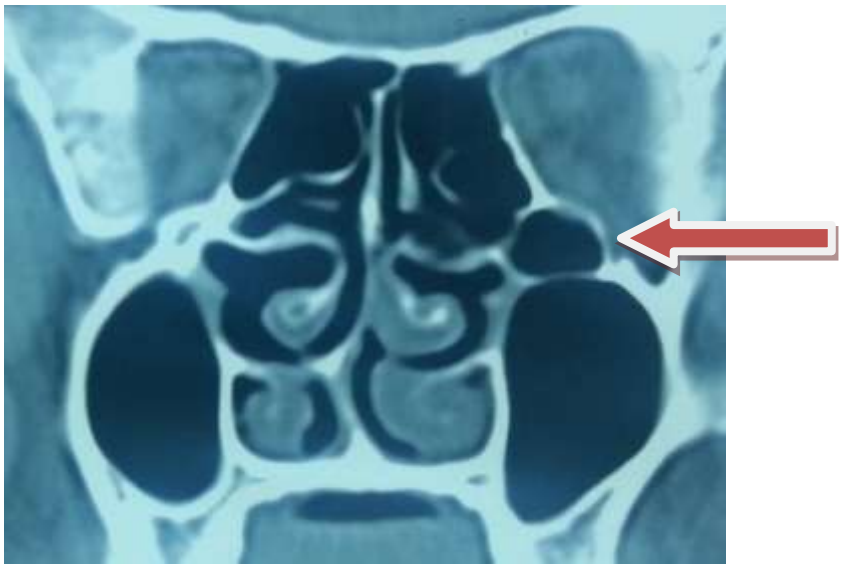
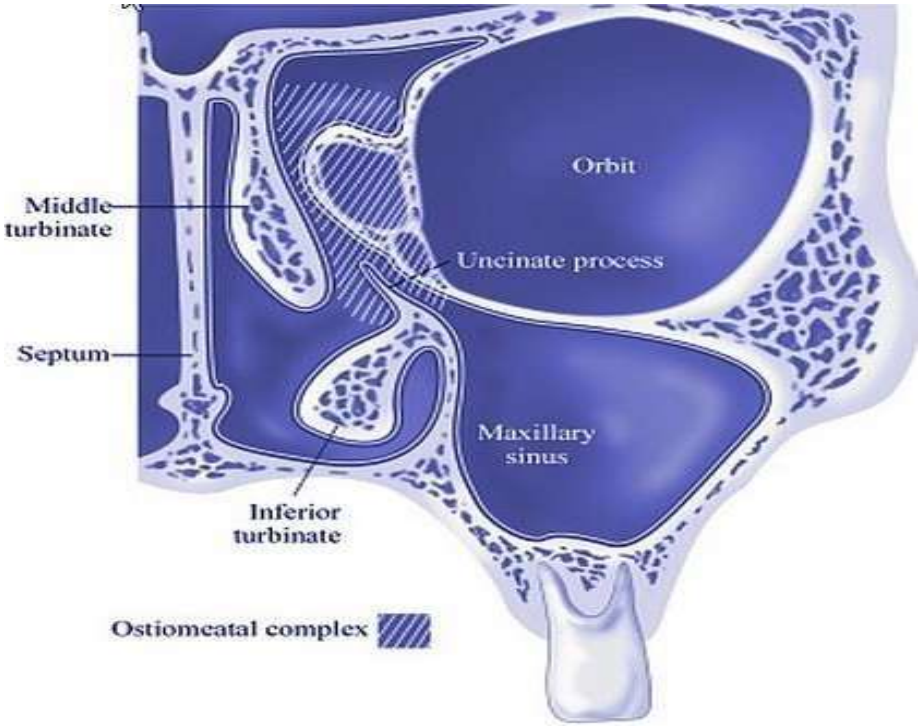


**Figure 9. Haller cell**

# DISCUSSION

## DISCUSSION

Over time, CRS surgical management has changed. Minimally invasive surgery has taken the role of external facial incisions, extensive nasal packing, and extended hospital stays. In order to restore normal airflow while protecting nearby mucosa, it is necessary to open the clogged ostia[42,43]. Despite the positive outcomes that have been documented in the literature to date[44,45], considering the proximity of the paranasal sinuses to critical structures like the orbit and skull




base, complications in surgery are typically damaging and hazardous.

**Figure 10. The Osteomeatal complex (OMC). The OMC - small compartment located in the region between the middle turbinate and the lateral nasal wall in the middle meatus - represents the key region for the drainage of maxillary, anterior ethmoid and frontal sinuses.**

The sinonasal area is prone to anatomical changes. The breadth of these variants has become clear as a result of recent developments in CT scanning and the widespread use of ESS, as well as the presence of universal agreement in the variation nomenclature and terminology. The osteomeatal complex (OMC), which is believed to be crucial in the pathophysiology of CRS, is

the area of interest. It is located in the lateral wall of the nose. Middle meatal blockage and consequent rhinosinusitis may be caused by local anatomic changes such as concha bullosa, deviated nasal septum (DNS), haller cells, paradoxical middle turbinates, agger nasi cells, and many others.

In our study, we discovered anatomical variation in the osteometatarsal complex of 87% of patients with chronic rhinosinusitis, out of whom 53.7% had two or more changes and the remaining 33.3% had just one. Similar results were published by Liu X et al, who found that chronic rhinosinuistis cases had an anatomical variation prevalence of nearly 81%[30]. According to Severino Aires de Araujo Neto et al. (2004), chronic rhinosinusitis cases' osteomeatal complexes had very few structural changes (65%). Similar incidence of structural changes was also noted by Perez et al. in instances of chronic sinusitis[32].

## NASAL SEPTAL DEVIATION

The development of the nose and paranasal sinuses depends on the nasal septum. It serves as the epiphyseal foundation for the growth of the facial skeleton[46]. The nasal septal deviation was found in 74.1% of the research participants (Table 7). A deviated nasal septum results in a reduction in the osteomeatal unit's essential area, which makes blockage and associated difficulties more likely. Similar findings were made by Perez et al, who estimated that 80% of people have a deviated nasal septum[32].

Al[25] 44%. In their separate studies[9,31], Dua et al and Asruddin et al revealed that the prevalence of a deviated nasal septum was 44% and 38%, respectively. In cases of chronic rhinosinusitis, Stallmann et al and Mamtha et al observed lesser prevalences of 60% and 65% deviated nasal septa, respectively[34,38]. In fact, the prevalence of nasal septal deviation was shown to range from 14.1% to 80% in several investigations, according to Dutra and Marchiori et al[47], Arslan et al[48], and Earwaker et al[49].

## CONCHA BULLOSA

Concha bullosa (pneumatized middle turbinate) has been suggested as a potential etiological factor in the development of chronic sinusitis that recurs on a regular basis. According to Tonai[26], it is because of its detrimental effect on middle meatus mucociliary clearance and

paranasal sinus ventilation. 53.7% of chronic rhinosinusitis cases had concha bullosa (unilateral 33.3%, bilateral 20.4%), which is very identical to the figures reported by Bolger et al[10] and Yousem et al[49], respectively. In chronic rhinosinusitis cases, Perez-Pinas et al. and Scribano et al. observed greater prevalences of concha bullosa, 73% and 67%, respectively[32,24].

When compared to the findings of Stallmann et al.[34], Maru et al.[29], Alkire BC et al.[39], and Azila A et al.[50], who reported that the prevalence of concha bullosa was 44%, 42.6%, 41.7%, and 40.8% respectively, the prevalence of concha bullosa in our study is on the higher side.

Further lower prevalence estimates of roughly 36%, 30%, 28%, 16%, 15%, 14%, and 15% were provided by Zinreich et al., Asruddin et al., Wani et al., Dua et al., Mamtha et al., Llyod et al., and Weinberger et al. [51,31,1,9,38,12,52].

## PARADOXICALLY CURVED MIDDLE TURBINATE

It is possible for the central turbinate to be paradoxically curved, or bent the other way. This could result in sinusitis and middle meatus impingement. Because it may obliterate or modify nasal air flow dynamics, Stammberger and Wolf[11] acknowledged paradoxical curvature of the middle turbinate as an etiological component for CRS. It was discovered in 14.8% of the patients, which is comparable to Asruddin et al's [31] and Llyod's[12] findings of 12% and 15%, respectively. It is lower than what Al-Qudah et al. and Bolger et al., respectively, reported as 18% and 27%[40,10]. Wani et al. 2009[1] noted a lower incidence of the middle turbinate.

## UNCINATE PROCESS OF THE ETHMOID BONE

We saw that the uncinate process could diverge or become pneumatized. Uncinate deviation can make it difficult for air to flow into the sinuses, especially in the anterior ethmoid, frontal recess, and infundibulum areas. The deviated uncinate was discovered in 9.3% of instances, which is greater than the rates reported by Bolger et al[29] 2.5%, Dua et al[9] 6%, and Asruddin et al[31] 2% but similar to the results of the study by Maru et al[29]. According to Llyod et al.[12], there is an estimated 16% prevalence of uncinate process deviation in instances of chronic rhinosinusitis, whereas Mamtha et al.[38] found a prevalence of 65%.

The ethmoid infundibulum and semilunar hiatus narrow due to hypertrophied uncinate process. It has also been proposed as a risk factor for the anterior group of sinuses and frontal sinus having poor ventilation. In comparison to the findings of Wani et al, who stated that it was 21% in cases of chronic rhinosinusitis[1], hypertrophy of the uncinate process was detected in only 5.6% of the patients.

## AGGER NASI CELLS

Just anterior to the anterosuperior connection of the middle turbinate and the frontal recess are agger nasi cells. These can encroach on the maxillary ascending process or the lacrimal bone. In our analysis, these cells were the least frequently detected, or 1.9%. Similar findings were made by Liu X et al[30], who reported that the prevalence of agger nasi cells ranged between 0.7% and 3% in instances of chronic rhinosinusitis, in contrast to the study by Dua et a[19], which discovered that agger nasi cells were present in 20 patients (or 40%). The prevalence is significantly lower than Bolger's[10] 98.5%, Maru's[29] 88.5%, Tonai and Baba's[26] 86.7%, and Asruddin's[31] 48%. who reported the Llyod et al[12].

Agger nasi cells were discovered during anatomical dissections by Messerklinger[5] in 10- 15% of specimens, Davis et al[53] in 65% of specimens, and Mosher et al in 40% of specimens[54]. Kennedy and Zinreich[55] saw an agger nasi cell in almost every patient on coronal CT imaging. The lower prevalence of agger nasi cells in our study may be attributable, in part, to the multiple definitions given to this anatomical variant and, in part, to the agger nasi cell's small size, which may make its detection challenging.

## HALLER'S CELL

Haller's cells were defined as ethmoid air cells by Zinreich et al[19] and Kennedy et al[56] as being located inferior to the ethmoid bulla adhering to the roof of the maxillary sinus, in continuity with the proximal infundibulum, and forming a portion of the infundibulum's lateral wall. They are regarded as ethmoid cells that extend onto the floor of the orbit and may enlarge the maxillary sinus ostium next to them, particularly if they contract an infection[23]. According to Davis et al.[53], the haller cell impinges on the ostium of the maxillary sinus and infundibulum by impeding ciliary action, resulting in blockage of the ostium.

In our investigation, the prevalence of Haller's cells was 1.9%, the same as the prevalence of agger nasi cells. Similar results were noted by Liu X et al[30], who reported that 297 cases of chronic rhinosinusitis in a study conducted at Sun Yat Sen University of Medical Sciences had a prevalence of roughly 1% Haller cells. Again, this is significantly less than the figures reported by Kayalioglu et al.[57] (5.5%), Dua et al.[9] (16%), Llyod et al.[23] (15%), Perez-Pinas et al.[32] (20%), Tonai and Baba[26] (36%), Bolger et al.[10] (45.9%), Maru et al.[29] (36%), Alkire BC et al.[39] (39.9%).

In a study on the morphological alterations in the osteomeatal complex in chronic rhinosinusitis (CRS) patients and comparisons with the general population, Azila A. et al. presented their findings. 120 patients with CRS and another 120 patients without the condition were compared in high quality CT scans of the paranasal sinuses of 240 people. Concha bullosa was observed in 49 (40.8%) CRS cases and 57 (47.5%) control cases. Paradoxical middle turbinates were observed in 14 (12%) CRS cases and 27 (23%) control cases. Pneumatized uncinate processes were discovered in 3 cases (3.3% in both the CRS and control groups). Haller's cells (infraorbital ethmoid cells) were observed in 61 (51%) CRS cases. Pneumatized agger cells were present in 100 (83%) CRS cases and 95 (79%) control participants. Deviated nasal septums were present in 67 (56%) CRS cases compared to 73 (60.8%) controls[50].

## FACTORS RESPONSIBLE IN INVOLVEMENT OF PARTICULAR SINUS

Although 85.2% of the study participants had maxillary sinus involvement, we found that. Concha bullosa and a deviated nasal septum were both highly linked to maxillary sinus involvement. Similar findings were reported by Caughey et al[37], who had noticed the connection between a maxillary sinus involvement and a deviated nasal septum and concha bullosa. Their research also revealed that the ethmoid and maxillary sinus diseases were brought on by Haller cells. Concha bullosa of the middle turbinate and septal deviation were found to be related with chronic sinusitis among all the studied paranasal variations, according to Ameri AA et al[36]. Additionally, for each paranasal sinus, there was a strong correlation between the existence of anatomic variations and the prevalence of chronic sinusitis.

But other anatomical variations of the osteomeatal complex observed in our study were not associated with the maxillary sinus involvement. We also observed that ethmoid and frontal sinus involvement had no associated factors. (Table 10,11).

The results in our study further emphasise that most probably, therhinosinusitis genesis is multifactorial, and the physiological factor (mucociliary clearance disorders) possibly is as much significant as the mechanical obstructive factor[58].

It is debatable whether anatomical variations in the nasal sinus region have any clinical importance. No correlation between the rate of ipsilateral and contralateral CRS and the existence of ipsilateral or contralateral DNS was found by Vincent et al[41]. There was no statistically significant difference between the DNS group and the non-DNS group with regard to the CRS, according to Yasan H et al[59] as well. There were no statistically significant differences between the CRS groups in the rates of CRS on the ipsilateral and contralateral sides of the DNS.

Vincent et al.[41] additionally noted that there was no statistically significant correlation between the presence of CB and an overall rise in the prevalence of ipsilateral CRS. It has been debatable if CB contributed to the development of CRS. Vincent et al findings were supported by Zinreich SJ et al.[60], Nadas S et al.[61], Aktas D et al.[62], Yousem D M[49], and Tonai et al.[26]. The researchers Lusk et al.[27] also found no evidence between concha bullosa to paediatric sinus illness.

Concha bullosa, also known as a pneumatized middle turbinate, is an anatomical variation of sinonasal morphology that is rather frequent. Although they are not believed to play a substantial role in the pathophysiology of chronic rhinusinusitis[12,13], their cited incidence ranges from 15% to 45% in the literature.

Despite what Arslan H et al[64] reported. In 63% of the patients analysed, Milczuk et al.[65] discovered a relationship between ipsilateral ethmoid-maxillary sinusopathy and childhood. As a result, this may not accurately depict how a CB's past led to the development of the OMC sickness.

The majority of sinus area CT anatomical studies have been performed on patients who are thought to have a clinical condition that could point to an inflammatory sinus disease. In contrast to the 11% in the normal control group, Zinreich[66] discovered that 62% of his patients had at

least one anatomic variation. These results appear to point to a potential relationship or clinical importance between structural variations and the emergence of inflammatory sinus disease. Bolger et al.[10] reported 131 anatomical variants in a series of 202 patients evaluated by CT, although they discovered that the incidence among patients with sinus pathology was comparable to that in people studied for other reasons. Calhoun et al.[67] compared 82 CTs from a study of orbital pathology with 100 CTs performed to assess sinus disease. Concha bullosa presence and septal deviation were more common in the first group. However, both studies found the presence of a paradoxical middle nasal concha, without ever associating it with a sinus abnormality. Only the concha bullosa, Llyod's[12] anatomical variant, was significantly related with a high incidence of sinusitis (85%). Both in patients treated for sinus issues and in those studied for other reasons, anatomical variants were found by Bolger et al.[68] and Stammberger and Wolf[11]. They came to the conclusion that, unless other linked factors are present, the simple presence of variations does not indicate a susceptibility to sinus pathology. Yousem[49] disagrees, claiming that depending on their magnitude, they might be predisposing factors.

According to Llyod et al.[23], there is no evidence that the anatomical variations in the middle meatus—concha bullosa, paradoxical middle turbinate, bent uncinate process, over-pneumatized bulla ethmoidalis, haller cells, and agger nasi cells—have any impact on sinus disease by leading to middle meatus stenosis.

However, Bolger et al[10] discovered that patients with sinusopathy had a much higher frequency of pneumatization of the bulbous area of the middle concha. Liu et al [30] have also shown that the incidence of connection with paranasal sinus mucosal modification at CT increases with the size of the anatomical variance.

If the anatomical variant determines obliteration of the aerial space of the osteomeatal complex drainage paths, Scribano et al[24] had observed that the sinusal disease was more frequently detected at CT than when the anatomical variant did not obstruct these pathways. This was true even when taking into account factors like subtype or size.

Some discrepancies in frequency between studies[10,24,26,27,30,47,58,69], definitions and rankings of the anatomical variant[10,70], application of evaluation techniques with various sensitivity levels (anatomical parts versus CT), as well as racial or population factors[26], can all be explained.

Furthermore, since a sinusal alteration on a CT scan does not always indicate a clinical condition, it is important to distinguish between clinical and tomographic sinusopathy[10,71,72,73,74].

Finally, it would be practical to estimate the risk of each mutation separately because they each appear to have a unique impact on the onset of sinus disease. Because some anatomical variants have a relatively low prevalence, few studies have a large enough sample size for a statistically valid data analysis.

Our study does have some limitations, though. Although there appears to be a likely correlation between the chronic rhinosinusitis cases and the high prevalence of anatomical variations of the osteomeatal complex (87%) seen in our study, this correlation cannot be statistically proven because there was no control group. Therefore, further research in a case control or cohort epidemiological design is required to find any significant correlation of anatomical variations with the causation of chronic rhinosinusitis cases.

# CONCLUSION

## CONCLUSION

- The majority of the patients were male and in the 11–40 age range, which is a comparatively younger age group.
- Nasal obstruction, postnasal drip, and headache were the most prevalent findings.
- Mucopurulent discharge, a deviated nasal septum, inferior turbinate hypertrophy, and middle turbinate hypertrophy were the most prevalent findings.
- In our study, bilateral maxillary sinusitis was the most typical presentation, with the maxillary sinus being the most often affected sinus.
- In our analysis, several anatomical variations were more common than a single anatomical variation.
- The most frequent anatomical variation we found in our analysis was a deviated nasal septum, followed by concha bullosa.
- The presence of nasal septal deviation and concha bullosa were strongly associated with maxillary sinus involvement.
- Diagnostic endoscopy and CT scan must be done prior to any functional endoscopic sinus surgery. They help in assessing the extent of sinus disease and to know the anatomical variations.

# SUMMARY

# SUMMARY

The present study was conducted in the Department of Otorhinolaryngology,SANTOSH MEDICAL COLLEGE & HOSPITAL,GZB from Oct 20 to April 22.
. The study was undertaken with the objective of assessing the incidence and role of anatomical variations of osteomeatal complex in chronic rhinosinusitis cases.

Patients with 50 instances of chronic rhinosinusitis in a row attended the E.N.T. department who had chronic sinusitis for longer than three months without improving with medical treatment and who were willing to have functional endoscopic sinus surgery.

There were 20 women and 30 men in our study. The most frequent symptom was nasal blockage (72.2%), followed by postnasal drip (68.5%) and headache (66.7%).

53.7% of the chronic sinusitis cases in our study exhibited two or more anatomical abnormalities, compared to 33.3% of the cases with just one. In the current investigation, it was discovered that among the structural changes in chronic sinusitis cases, a deviated nasal septum (74.1%) was the most prevalent. This was followed by a unilateral concha bullosa (33.3%) and a paradoxically bent middle turbinate (14.8%). In one case each, Agger nasi cells and Haller cells were observed.

The maxillary sinus was involved in 85.2% of the individuals in our study, followed by the ethmoid sinus (31.5%). Out of all the structural changes in the osteomeatal complex, nasal septal deviation and concha bullosa were highly related with maxillary sinus involvement.

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# ANNEXURE

## PROFORMA

Name of the Patients:

Age/Sex : Case No:

Religion : Reg. No. IP/OP/No. :

Occupation : Date of Admission :

Income : Date of Discharge :

Address : Diagnosis :

Chief Complaints:

[A] Present History

1) Nasal Discharge (Rhinorrhoea): Duration :

Onset & Progress :

Unilateral/ Bilateral :

Diurnal Variation :

Seasonal Variation :

Quality :

Watery / Mucoid / Mucopurulent / Purulent

Colour :

Odour :

Any Other :

2) Nasal Obstruction: Duration :

Onset & Progress : Unilateral/ Bilateral : Diurnal Variation : Seasonal Variation :

3) Headache / Facial Pain: Duration :

Onset & Progress : Site :

Postural Variation : Seasonal Variation : Localized Radiating : Aggravating :

Reliving Factors :

Any Other :

4) Post-Nasal Discharge; Quality :

Colour :

Odour :

5) History of Epistaxis:

6) History of sneezing:

Duration :

Onset & progress :

Seasonal Variation :

Aggravating Factors :

Relieving Factors :

7) H/O Allergy :

8) H/O Fever :

9) H/O Cough :

10) Abnormalities of Smell (If any):

Hyposmia/Parosmia/Anosmia/Cacosmia.

11) Any Other Symptoms:

[B] Past History:

H/O similar Complaints in past- Any treatment taken: Medical- Surgical.

H/O TB/HT/DM/ any exposure

[C] Personal History

Diet : Adequate/ Inadequate, Veg/ Non-Veg Appetite :

Sleep :

Micturation :

Bowel :

Habits: Smoking, Beedis/ Cigarettes since Years/ months.

Tobacco Chewing since Years

[D] Family History:

H/O Similar complaints in family members-

[I] General Physical Examination:

Built and Nourishment: Good / Moderate / Poor. Pallor / Cyanosis / Clubbing:

Icterus / Lymphadenopathy: Vital Signs:

Pulse Rate : /min

Temperature :

Blood Pressure : mm of Hg.

Respiratory rate : Per min. Examination of Face :

Quality of Voice :

[II] Systemic Examination

1) Respiratory System:

2) Cardio-Vascular System:

3) Per Abdomen:

4) Centeral Nervous System:

[III] E.N.T. Examination

1. Examination of Nose:

a) External Appearance:

b) Cold Spatula Test :

c) Anterior Rhiniscopy :

i) Vestibule :

ii) Mucosa: Pale/ Edematous/ Congested/ Crusting

iii) Septum:

iv) Cavity:

Right left

v) Turbinates Inferior Middle

vi) Meati Inferior Middle

Olfactory Cleft

vii) Floor :

Viii) Roof :

ix) Any Other abnormality :

d) Examination of Paranasal Sinuses:

Right Left

(i) Frontal

(ii) Ethmoidal

(iii) Maxillary

e) Posterior Rhinoscopy:

2. EXAMINATION OF ORAL CAVITY AND OROPHARYNX

a) Oral cavity :

b) Oropharynx :

Pillars :

Tonsils :

Palate :

Uvula :

Posterior Pharyngeal Wall:

c) Indirect Laryngoscopy:

3. EXAMINATION OF EARS;

(i) External Apperance

(ii) External Auditory Canal

(iii) Tympanic Membrane

(iv) Siegelisation Test :

(v) Tuning Fork Tests:

Rinne's Weber's ABC;

(vi) Mastoid tenderness

(vii) Facial Nerve Examination:

INVESTIGATIONS

1) Blood:

a) Haemoglobin:

b) ESR:

c) Total WBC Count:

d) Different WBC Count:

Neutrophils: Eosinophils: Basophils:

Lymphocytes: Monocytes:

e) Absolute Eosinophil Count:

f) Bleeding Time:

g) Clotting Time:

2) Urine: Albumin: Sugar: Micro:

3) X-ray PNS:

4) Nasal Swab for Culture and Sensitivity:

5) DIAGNOSTIC ENDOSCOPY:

Nasal endoscopic findings:

1) Floor of the Nose:

2) Septum:

3) Inferior meatus:

4) Inferior Turbinate:

5) Middle Turbinate:

6) Nasopharynx:

7) Sphenoid ethmoid recess:

8) Posterior tip of turbinate:

9) Middle Meatus:

10) Hiatus Semilunaris:

11) Ethmoidal Bulla

12) Uncinate:

13) Nasal polyps:

14) Frontal Recess:

15) Anatomical Variations:

i. Agger Nasi Cells:

ii. Accessory Maxillary ostium:

iii. Bulla ethmoidalis:

iv. Uncinate Process:

v. Middle Turbinate:

vi. Onodi cells:

vii. Septal Deviation:

6) COMPUTED TOMOGRAPHIC FINDINGS: Plain / Contrast

Axial / Coronal

i) Frontal Sinus

ii) Nasolacrimal Duct

iii) Anterior ethmoids

iv) Infundibulum

v) Maxillary Sinus

vi) Middle meatus

vii) Frontal recess

viii) Polyps

ix) Posteriors ethmoids

x) Sphenoid ethmoid recess

xi) Sphenoid

xii) Agger nasi cells

xiii) Haller‟s Cells

xiv) Ethmoid Bulla

xv) Uncinate Process

xvi) Middle Turbinate

xvii) Onodi Cells

xviii) Septal Deviation

xix) Accessory Maxillary ostium.

DIAGNOSIS: TREATMENT:

Procedure Performed:

# DEPARTMENT OF ENT

# SANTOSH MEDICAL COLLEGE & HOSPITAL

# GHAZIABAD, U.P

You are being requested to take part in a study entitled

"ANATOMICAL VARIATIONS OF THE OSTEOMEATAL COMPLEX IN CHRONIC RHINOSINUSITIS : AN OBSERVATIONAL STUDY"

VOLUNTARY PARTICIPATION

Your participation in the study is entirely voluntary and you are free to withdraw

From the study as and when you feel so.

CONSENT FORM

I, _____ Son/ Daughter/ Wife of _____ Resident of

_____ Hereby declare that I give my

Full, free and voluntary informed consent in the thesis

"Effect of Intranasal Steroids on Nasal Mucociliary Clearance on Allergic Rhinitis"

Dr._____ has informed me to my full satisfaction, in the language I

Understand, about the purpose, nature of study and various laboratory investigations for

The study is to be carried out. I have been informed about the duration of the study and

Instructions to be followed during the study period.

I give full consent for being enrolled in the above study and I reserve my rights to

Withdraw from this study, whenever I wish without prejudice of my right to undergo

Further treatment at Santosh Hospital, Ghaziabad, U.P.

Patient's/ Patient's relative's signature Doctors signature

Or thumb impression

Name: Date:

We have witnessed that the patient signed the above form in the presence of his free

Will after fully understanding its content.

1. Signature of witness 2. Signature of investigator

Name: Name:

Dr. RAVI GUPTA

Post Graduate Student

Batch: 2020-2023

Department of ENT

Santosh Medical College & Hospital

Ghaziabad – 201001 (U.P)

Phone no. 9936468425

# संतोष मेडिकल कॉलेज एवं अस्पताल (गाजियाबाद)

## सूचितसहमति

"ANATOMICAL VARIATIONS OF OSTEOMEATAL COMPLEX IN CHRONIC RHINOSINUSITIS: AN OBSERVATIONAL STUDY"

मैं _____बेटा/ बेटी_____

निवासी_____ घोषणा करता हूं

कि, डॉ._____, ने मुझे मेरी भाषा में अपने अध्ययन,

अध्ययन के उद्देश्य के बारे मे, और अध्ययन के दौरान अपना ईजानेवाली विभिन्न प्रयोगशाला जांच के बारे में सूचित कर दिया है। मुझे अध्ययन की अवधि और उसके दौरान अपना एजाने वाले निर्देश भी मेरी भाषा मे समझा दिए गए हैं| मैं उपरोक्त अध्ययन में बिना किसी दबाव के दाखिला ले रहा हूं और पूर्ण सहमति दे रहा हूं| सन्तोष अस्पताल, गाजियाबाद में अपने आगेके उपचार पर बिना प्रतिकूल प्रभाव डाले इस अध्ययन से और प्रयोगशाला जांच कीप्रकृति से मैं जब चाहूँ बाहर जाने के अपने अधिकार को सुरक्षित रख रहा हूं|

रोगी के रिश्तेदार के हस्ताक्षर:
या अंगूठे का निशान
नाम
दिनांक:

गवाह के हस्ताक्षर

Signature of Investigator

Dr. RAVI GUPTA

Post Graduate Student

Batch: 2020-2023Department of ENT

Santosh Medical College & Hospital

Ghaziabad – 201001 (U.P.)

Phone no. 9936468425

## KEY TO MASTER CHART

- NO - Nasal obstruction
- ND - Nasal discharge
- PND - Post nasal drip
- SNZ - Sneezing
- H - Headache
- FP - Facial pain
- NM - Nasal mucosa
- IT - Inferior turbinate
- MT - Middle turbinate
- IM - Inferior meatus
- MM - Middle meatus
- DNS - Deviated nasal septum
- CB - Concha bullosa

- OC - Onodi cell
- MT - Middle turbinate
- U - Uncinate
- AN - Agger nasi cell
- HC - Haller cell
- BE - Bulla ethmoidalis
- MS - Maxillary sinus
- ES - Ethmoidal sinus
- SS - Sphenoid sinus
- FS - Frontal sinus
- N - Normal
- H - Hypertropheid
- MP - Mucopurulent
- D - Deviated

- P - Present
- PB - Paradoxically bent
- H - Hypertrophy
- \+ - Present
- \- - Absent
- 1 - Involved
- 0 - Not involved

| | Name | IP NO | Age | Sex | Symptoms | | | | | | Signs(dne) | | | | | | | | | | Ct findings | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | NO | ND | H/P | PND | SNZ | NM | IT | | MT | | IM | | MM | | DNS (DNE) | | DNS | | CB | | OC | | MT | | U | | AN | | HC | | BE | | | | | |
| | | | | | | | | | | | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | MS | ES | SS | FS |
| 1 | Arpitha | | 19Y | F | + | - | + | + | - | N | N | N | N | N | N | N | N | N | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 2 | Monica | | 18Y | F | + | - | + | + | - | N | N | N | N | N | N | N | N | N | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 3 | Umesh | | 22Y | M | + | - | + | + | - | N | N | H | N | H | N | N | MP | N | D | - | D | - | - | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 4 | Jyothi | | 18Y | F | - | - | + | + | + | H | N | N | N | N | N | N | N | N | - | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 5 | Banakar | | 69Y | M | - | - | + | + | - | N | N | H | N | N | N | N | MP | N | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 6 | Ragvendra | | 35Y | M | + | - | + | + | - | N | N | N | N | N | N | N | N | N | - | - | - | - | P | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 7 | Swetha bai | | 15Y | F | + | + | + | + | - | N | N | H | N | N | N | N | MP | MP | D | - | D | - | - | - | - | - | - | PB | - | - | - | - | - | - | | 1 | 1 | 0 | 0 |
| 8 | Arun kumar | | 18Y | M | + | + | - | - | - | N | H | N | N | N | N | N | MP | N | - | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 9 | Eramma | | 61Y | F | + | - | - | - | - | N | N | N | H | H | N | N | N | N | - | - | - | - | P | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 10 | Nagamma | | 45Y | F | - | + | - | - | - | N | H | N | N | N | N | N | N | MP | - | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 11 | Sakkamma | | 23Y | F | - | - | - | + | - | N | N | N | H | N | N | N | N | N | D | - | D | - | P | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 12 | Girijamma | | 55Y | F | + | - | - | + | - | N | H | N | N | N | N | N | MP | N | - | D | - | D | - | - | - | - | PB | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 13 | Avinash | | 20Y | M | + | - | - | + | - | N | N | N | H | H | N | N | N | N | - | - | - | - | P | P | - | - | - | - | - | - | - | - | - | | - | 1 | 0 | 0 | 0 |
| 14 | Halesh Naik | | 28Y | M | + | + | - | + | - | N | H | N | N | H | N | N | N | MP | - | D | - | D | - | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 0 | 0 |
| 15 | Harish | | 27Y | M | + | + | + | - | - | N | H | N | H | H | N | N | MP | MP | - | D | - | D | P | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 16 | Basavaraj | | 31Y | M | + | + | + | + | - | N | N | N | H | N | N | N | MP | N | - | - | - | - | P | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 17 | Lalita bai | | 35Y | F | + | + | + | + | - | N | N | N | N | N | N | N | N | MP | D | - | D | - | - | - | - | - | - | - | - | D | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 18 | Lokeshappa | | 54Y | M | + | + | + | + | - | C | N | N | N | N | N | N | N | MP | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | 1 | 0 | 0 |
| 19 | Gayathri | | 16Y | F | - | + | + | - | - | C | N | N | N | N | N | N | MP | N | - | D | - | D | - | - | - | - | - | - | - | D | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 20 | Meenakshamma | | 28Y | F | - | + | + | + | - | C | N | H | H | H | N | N | MP | N | D | - | D | - | P | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 21 | Manjunath | | 26Y | M | - | - | + | + | - | N | H | N | H | N | N | N | N | MP | - | D | - | D | P | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 0 | 0 |
| 22 | Haseena banu | | 31Y | F | + | - | + | + | - | N | N | N | N | N | N | N | N | N | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 23 | Subramanya | | 57Y | M | + | - | + | + | - | N | N | N | N | N | N | N | N | MP | - | - | - | - | P | - | - | - | - | PB | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 24 | Shamsheer baig | | 50Y | M | + | - | + | + | - | N | N | N | N | N | N | N | MP | N | - | D | - | D | - | - | - | - | - | - | - | D | - | - | - | - | | 1 | 0 | 0 | 0 |
| 25 | Swetha | | 15Y | F | + | - | + | - | - | N | H | N | H | H | N | N | N | MP | - | D | - | D | P | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 26 | Lakshmi | | 23Y | F | + | + | - | - | - | N | N | H | N | H | N | N | MP | MP | D | - | D | - | P | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 27 | Rajappa | | 45Y | M | - | + | + | - | - | N | N | N | N | N | N | N | MP | N | - | - | - | - | - | - | - | - | - | D | - | - | - | - | - | - | - | 0 | 1 | 0 | 0 |

| | Name | IP NO | Age | Sex | Symptoms | | | | | | Signs(dne) | | | | | | | | | | Ct findings | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | NO | ND | H/FP | PND | SNZ | NM | IT | | MT | | IM | | MM | | DNS (DNE) | | DNS | | CB | | OC | | MT | | U | | AN | | HC | | BE | | | | | |
| | | | | | | | | | | | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | MS | ES | SS | FS |
| 28 | Paramma | | 47Y | F | - | - | + | - | - | N | H | N | H | N | N | N | MP | N | - | D | - | D | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 29 | Rajsekhar | | 38Y | M | + | + | + | + | - | N | N | H | N | N | N | N | MP | N | D | - | D | - | - | - | - | - | - | - | - | - | - | - | | - | 1 | 0 | 0 | 0 |
| 30 | Rathnamma | | 38Y | F | + | + | - | + | - | N | H | N | H | N | N | N | MP | N | - | D | - | D | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 31 | Punit | | 32Y | M | + | + | - | + | - | N | H | N | H | H | N | N | N | MP | - | D | - | D | P | P | - | - | PB | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 32 | Gangadharappa | | 42Y | M | + | + | + | - | + | C | H | N | H | H | N | N | MP | N | - | D | - | D | P | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 0 | 0 |
| 33 | Sharath | | 18Y | M | - | + | + | - | - | N | N | H | N | N | N | N | N | N | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 34 | Prasanna kumar | | 54Y | M | - | + | - | - | - | N | N | N | N | N | N | N | MP | N | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | 1 | 0 | 0 |
| 35 | Chandrasekar | | 39Y | M | - | - | + | - | - | C | N | N | N | N | N | N | N | MP | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | 1 | 0 | 0 |
| 36 | Geetha | | 22Y | F | + | + | - | - | - | N | N | N | H | N | N | N | MP | N | - | - | - | - | P | - | - | - | - | - | - | | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 37 | Narappa | | 43Y | M | + | - | - | - | - | N | N | H | H | H | N | N | N | MP | D | - | D | - | P | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 0 | 0 |
| 38 | Gurumurthy | | 28Y | M | + | + | - | + | - | N | H | N | N | H | N | N | N | MP | - | D | - | D | - | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 0 | 0 |
| 39 | Shiv kumar | | 16Y | M | + | + | - | + | - | N | N | H | H | N | N | N | MP | N | D | - | D | - | P | - | - | - | - | - | - | H | P | - | - | - | - | 1 | 0 | 0 | 0 |
| 40 | Umme hani | | 29Y | F | + | + | + | + | - | N | H | N | H | N | N | N | MP | N | - | D | - | D | P | - | - | - | - | PB | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 41 | Narayan swamy | | 33Y | M | - | + | + | + | - | N | H | H | N | N | N | N | MP | MP | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 42 | Veeresh | | 26Y | M | - | + | + | + | - | N | N | H | H | N | N | N | N | N | D | - | D | - | P | - | - | - | - | - | - | - | - | - | - | - | - | 0 | 1 | 0 | 0 |
| 43 | Balaram | | 32Y | M | + | - | + | + | - | N | N | H | H | H | N | N | N | MP | D | - | D | - | P | P | - | - | - | - | H | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 44 | Ranjith | | 26Y | M | + | + | + | + | - | N | N | H | N | N | N | N | MP | N | D | - | D | - | P | - | - | - | PB | - | - | - | - | - | - | - | - | 1 | 1 | 0 | 0 |
| 45 | Sujathamma | | 36Y | F | + | - | + | + | - | N | N | N | N | N | N | N | MP | N | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | 1 | 1 | 0 | 0 |
| 46 | Siddalingappa | | 38Y | M | + | - | + | + | - | C | N | H | N | H | N | N | MP | N | D | - | D | - | - | P | - | - | - | - | H | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 47 | Sunil | | 31Y | M | + | - | + | + | - | C | N | N | N | N | N | N | MP | N | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 1 |
| 48 | Sujathamma | | 39Y | F | - | - | + | + | - | N | N | H | H | H | N | N | N | MP | D | - | D | - | P | P | - | - | - | - | - | - | - | - | - | - | - | 1 | 0 | 0 | 0 |
| 49 | Rangamma | | 47Y | F | + | + | - | + | - | N | N | N | N | N | N | N | MP | MP | D | - | D | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 50 | Manas | | 28Y | M | + | - | + | - | + | N | N | N | N | N | N | N | N | MP | - | D | - | D | P | P | - | - | PB | - | - | - | - | - | - | P | | - | 1 | 0 | 0 | 0 |

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(Established u/s 3 of the UGC Act, 1956)

F. No. SU/2021/1830[67] Dated: 17.07.2021

Subject: Grant of Ethical Clearance for Thesis Protocol Topic **"AN OBSERVATIONAL STUDY ON THE ANATOMICAL VARIATION OF OSTEOMEATAL COMPLEX ON THE CASES OF CHRONIC RHINOSINUSITIS",** submitted by **Dr. Ravi Gupta,** MD/MS student of Batch 2020-2021, Department of **ENT**.

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With reference to his/her request for grant of Ethical Clearance for the Thesis Protocol entitled **"AN OBSERVATIONAL STUDY ON THE ANATOMICAL VARIATION OF OSTEOMEATAL COMPLEX ON THE CASES OF CHRONIC RHINOSINUSITIS", Dr. Ravi Gupta** is informed that the Thesis Protocol submitted by him/her was considered by the **Screening Committee** of the Santosh Medical College & Hospital in its meetings held on 19.03.2021, 22.03.2021, 24.03.2021, 25.03.2021, 26.03.2021, 27.03.2021 and 06.04.2021. The recommendations of the **Screening Committee** were considered in detail by the Institutional **Ethics Committee** in its meeting held on **12.07.2021** and the same was **approved** by the **Ethics Committee**.

He /She is informed accordingly for further necessary action.

[Dr. V. P. Gupta]
REGISTRAR

SANTOSH DEEMED TO BE UNIVERSITY REGISTRAR GHAZIABAD, NCR DELHI

**Dr. Ravi Gupta**
MD/MS student of batch 2020-2021
Department of ENT
Email: luckynoida@gmail.com

**Copy to:**

1. The Vice Chancellor
2. The Dean, SMC&H
3. The Dean – Research
4. The Dean – Academics
5. The Director - IQAC
6. Dr. Sushil Gaur (Guide)
7. HOD of **ENT**

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| **Submitter email** | drjyotibatra89@gmail.com |
| **Similarity** | 3% |
| **Analysis address** | drjyotibatra89.sug@analysis.urkund.com |